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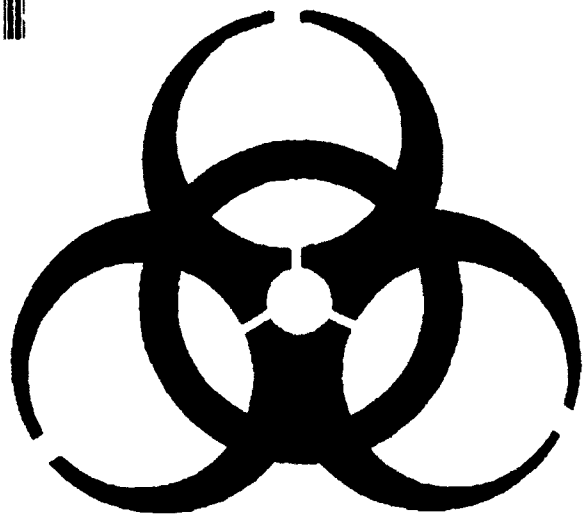
Managing the Navy's Infectious Medical Waste



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1.0 Introduction

During the summers of 1987 and 1988, medical waste sightings on beaches from North Carolina to Massachusetts as well as on the beaches of the Great Lakes, closed beaches and immediately brought to public attention the need for proper management of medical related wastes. Since that time, the public demand for this management has been further fueled by the increasing awareness of the AIDS epidemic. Meanwhile, the quantity of medical waste generated has increased with the increased desire on the part of the healthcare industry to use disposable items in order to reduce the possibility of infection during treatment. The Occupational Safety and Health Administration's new regulation on bloodborne pathogens is also serving to increase the quantity of items considered to be infectious waste.

The Navy generates infectious medical waste in treatment facilities ranging from large hospitals in excess of 1,000 beds, to small outpatient clinics. In addition, significant amounts of medical waste are generated by ships. Current management of this waste includes on-site incineration, on-site treatment followed by both on-site and off-site disposal, and contracted removal. Because of the Navy's presence throughout the world, there is a myriad of local, county, state and national regulations that must be complied with in any method of disposal. In addition to regulatory compliance, management decisions are influenced by analysis of other risks involving public perception. That is to say, with certain treatment alternatives, there is a risk that items which are rendered non-infectious or are non-infectious from the start may turn up in the hands of the public. If these items are identifiable as related to medical treatment, there can be a false public perception that infectious waste is being disposed of improperly.

1.1 Objectives

The objectives of this report are as follows:

1. Summarize the type, quantity and sources of medical waste generated by the

Navy.

2. Review infectious medical waste treatment and disposal alternatives currently used or available to the Navy.
3. Evaluate current naval instructions and policies on medical waste, for compliance with applicable regulations.
4. Identify weaknesses in the Navy's overall management of infectious medical waste and recommend corrective action that can be taken to achieve more effective management policy.

1.2 Scope

This study will use resources available from the University of Texas, The Bureau of Medicine and Surgery, The Navy Environmental Health Center, and the Joint Commission on the Accreditation of Healthcare Organizations. The study will also incorporate previous work accomplished and experience gained while serving as Head, Facilities Management Department at Naval Hospital, Marine Corps Base Camp Pendleton. State and local regulations vary widely, therefore, a comprehensive analysis of such regulations is beyond the scope of this report. However, state and local regulations which are progressive or unique will be addressed.

1.3 Rationale

With the large volumes of medical waste generated by the Navy in various treatment settings distributed throughout the world, and with increasing complexity of infectious medical waste regulations, it is essential for the Navy to develop and maintain an effective medical waste management strategy. This strategy must effectively reduce risk, control cost, provide for continuous improvement and portray to the public a commitment to protect human health and the environment.

2.0 Description and Sources of Infectious Waste Generation

The Navy generates infectious waste from a wide variety of sources. Medical Treatment Facilities (MTFs) and Dental Treatment Facilities (DTFs) are shore based facilities which vary in size from large hospitals in excess of 700 beds to small outpatient clinics. MTFs and DTFs generate the largest portion of infectious waste within the Navy. Other generators of infectious waste include ships, relocatable medical units such as Fleet Hospitals, and smaller field units such as the medical staff assigned to Marine units. Although currently unaccounted for, medical waste is also generated through the home healthcare of retired and dependent personnel.

Prior to 1991, little or no tracking of the quantity of infectious waste generated was done by the Navy. However, in fiscal year (FY) 1992, a survey was done of the MTFs and DTFs to retroactively determine the quantity of infectious waste that had been generated from FY 1988 through FY 1991. This survey was done in terms of dollars that had been spent on infectious waste disposal rather than in terms of volume or weight. The survey does not

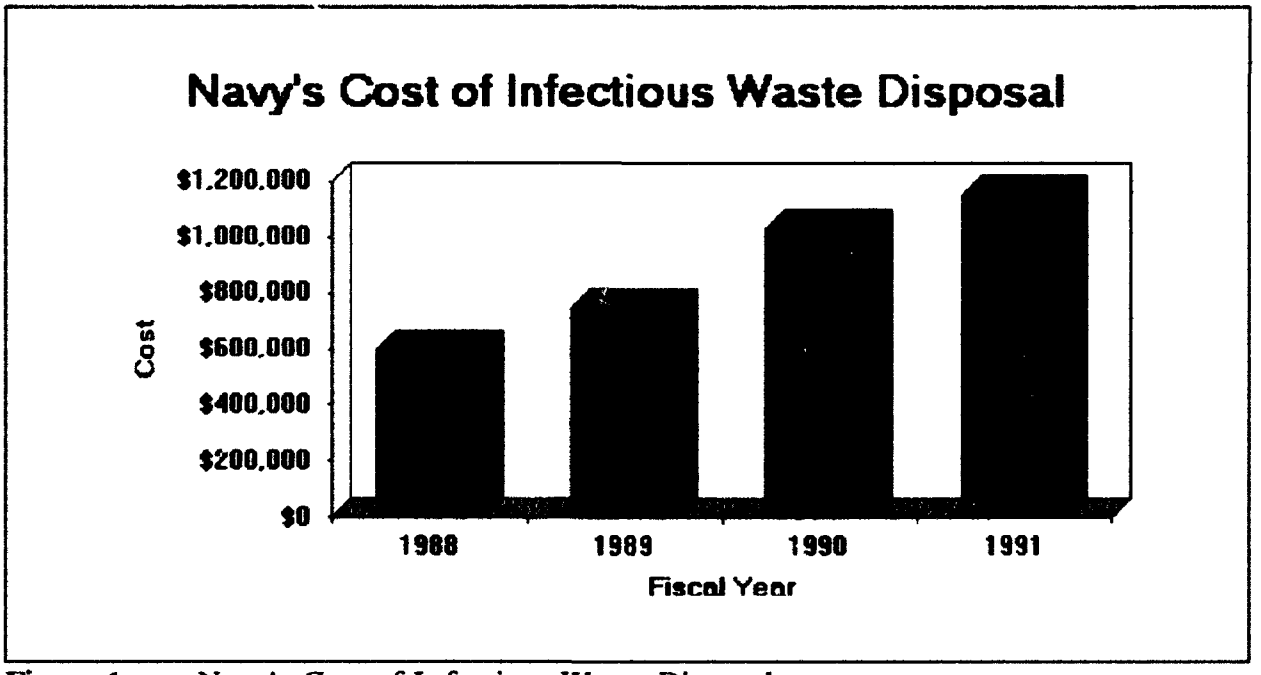

Figure 1 Navy's Cost of Infectious Waste Disposal

include infectious waste generated aboard ships except in the case where a ship deposits its infectious waste with the MTF while in port. Specific accounting of infectious waste generated by ships could not be found. The cost figures for the four year period are presented in Figure 1. The correlation between this cost data and the actual quantity of infectious waste which it represents would be extremely difficult to determine. In fact, the accuracy of this cost data could be questioned as it was compiled from the comptroller's records from each facility based on items that were actually charged to an infectious waste account. For example, if a particular facility was using an on-site incinerator for infectious waste disposal, there is a good chance that there was not a separate meter on the fuel to the incinerator. In that case, the major cost of disposal would not be accounted as an infectious waste disposal cost but as a utility cost. As another example, consider a facility which uses a steam sterilizer followed by disposal to the base landfill. Most likely, the steam would be tied into a non-metered steam lime from the hospital and the cost of steam generation would not be accounted. In some of these configurations, the sterilized waste is then disposed of in the same compactor as the non-infectious waste prior to being hauled to the landfill. In this case, it would be difficult to separate the hauling charges of the infectious waste from that of the non-infectious waste. It is possible that the cost figures shown above more closely represent the infectious waste that was disposed of through an infectious waste contract. Finally, even if the monetary accounting was done accurately, the treatment and disposal methods used and the cost of each method vary so widely among facilities spread throughout the world, that calculation of a total quantity based on average cost of disposal would be highly inaccurate.

As mentioned above, it does not appear that any detailed quantification of infectious waste generated by ships has been done. Much of the infectious waste on ships is sterilized and then stored until the ship returns to port. Infectious wastes which are paper or cardboard can be incinerated while at sea using a shipboard incinerator. Liquid wastes such as blood or other bodily fluids are either discharged to the sanitary system of the ship or must be autoclaved and stored. Infectious waste which is stored for disposal in port is either disposed of at the nearest Medical Treatment Facility or in many cases the port or Naval Station has its own contract for infectious waste disposal. The regulations for shipboard treatment and

disposal are discussed in Chapter 4.

The characteristics of infectious waste generated by the Navy do not differ greatly from the infectious waste generated by the civilian sector of the healthcare industry. However, one difference is the potential for a large variation in quantity during wartime. This variation during war is not necessarily an increase at any particular facility. During Operation Desert Storm/Desert Shield, a decrease in infectious waste occurred at Camp Pendleton as troops and medical staff were deployed to the Persian Gulf. However, during the same period, the facility had to make preparations to experience a large increase in infectious waste in the event that large numbers of casualties occurred. During times of large fluctuations in waste volume, facilities which have on-site treatment systems may have to supplement these systems with contracted disposal. Both military and civilian hospitals may also experience fluctuations in waste volume due to regional events such as natural disasters or infectious disease outbreaks or epidemics. Contracts for waste disposal should contain provisions to accommodate reasonable fluctuations in the wastestream.

It is difficult to describe characteristics of the infectious waste from a typical facility. The wastestreams vary widely due to variations in State regulations, hospital policies and waste management practices, and to the wide variety of facilities which generate infectious waste (i.e. laboratories, hospitals, clinics, research facilities, etc). An infectious wastestream substantially consists of paper, cardboard, plastic, fabric and fluids. National estimates place the quantity of waste between thirteen and twenty-three lbs/bed/day (Shumaker, 1990). One

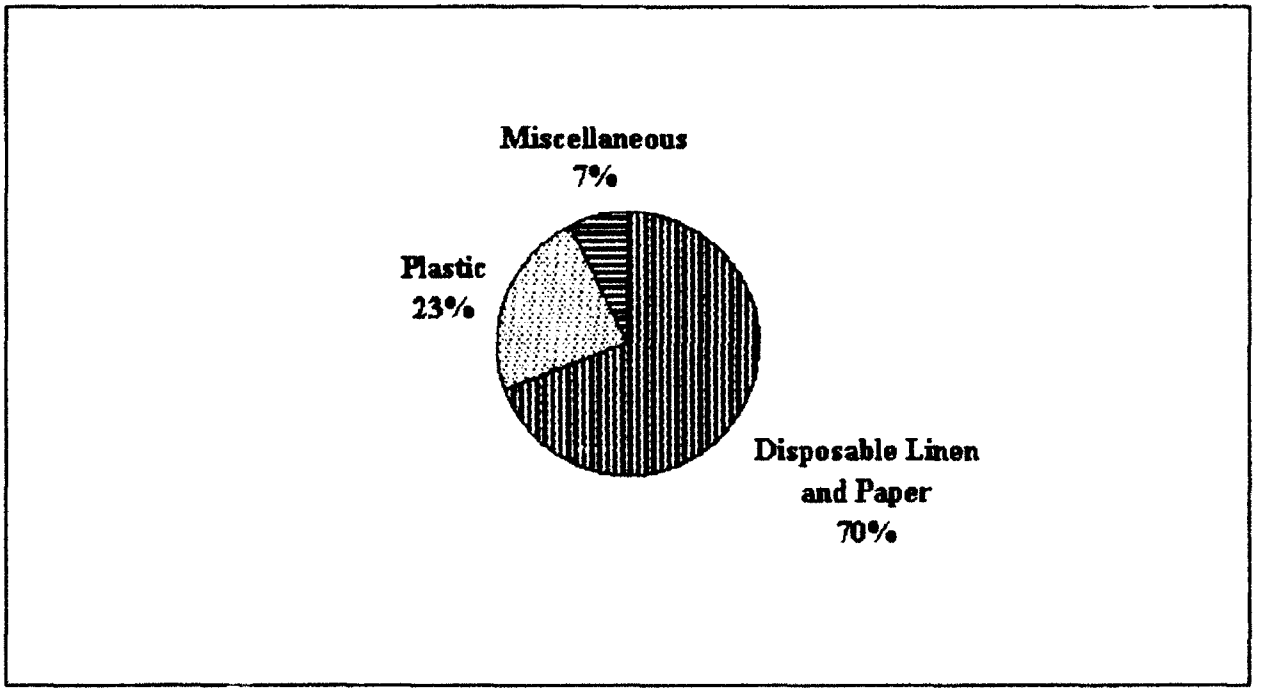

Figure 2 Components of Surgical Waste by Volume Percentage

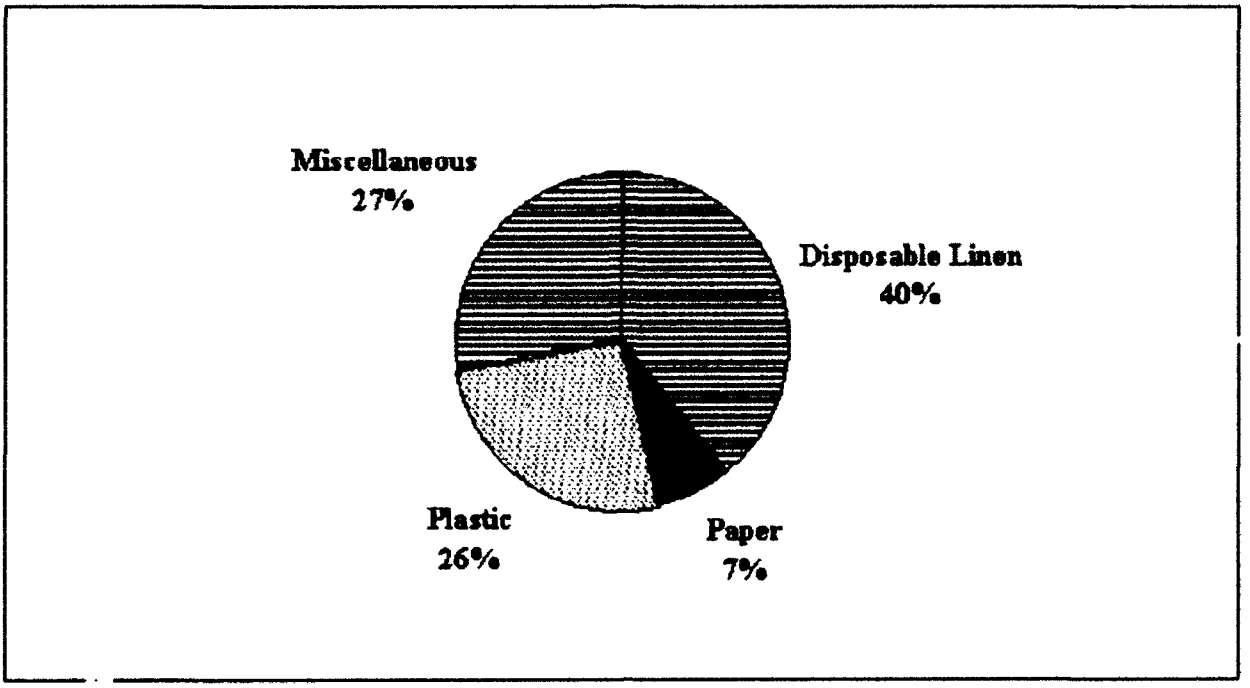

Figure 3 Components of Surgical Waste by Weight Percentage

study further characterized surgical waste into components by both volume and by weight as shown in Figure 2, Figure 3 and Figure 3 (JAMA, 1992;267). The study also estimated that by "using reusable linen products and recycling methods currently available and feasible, weight reductions of 73% and volume reductions of 93% in surgical waste are possible." From my experience at Naval Hospital, Camp Pendleton, the red bags which come from the operating rooms contain waste which is most consistently medically related. That is, people are not eating pizza and reading newspapers in the operating rooms, therefore pizza boxes and newspapers do not appear in the red bags from the operating rooms. If red bags from other parts of the hospital were examined, it is expected that the percentage of items which can be eliminated from the red bags would increase above that reported for the surgical waste. In fact, I have observed many red bags in several hospitals in which 100% of the waste could be discarded as regular trash.

3.0 Terminology, Definitions and Classification of Infectious Medical Waste

The definition of infectious waste varies widely from state to state and even from facility to facility. In fact, there is not even an agreement in terminology used to describe this waste (Reinhardt and Gordon 1991). As an illustration of this variation in terminology, Table I shows a comparison of terms used among several states (Shumaker 1990). Other terms that are used include, red bag waste, pathological waste, medical waste, infective waste and microbiological waste. This lack of consistency in terminology and definition of infectious waste has been one cause of improper waste management. In a letter to the EPA

Table I Terms Used to Describe Infectious Waste

State	Term Used to Describe Infectious Waste
Florida	Infectious, Biohazardous
Georgia, Connecticut	Biomedical
Iowa	Medically Hazardous
New Jersey, New York	Regulated Medical Waste
Indiana	Infectious Medical Waste
Massachusetts	Physically Dangerous Medical or Biological Waste
Illinois	Hazardous (Infectious) Hospital Waste
California	Biomedical Waste
Texas, Delaware	Special Waste
Maryland	Special Medical Waste
Louisiana	Potentially Infectious Medical Waste
Mississippi	Non-Hazardous Infectious Waste
Arkansas	Special Waste from Health Care Related Facilities

dated August 1, 1988, the American Hospital Association (AHA) stated "lack of a consistent and rational definition of infectious waste for use by federal, state and local agencies creates the most significant obstacle to efficient waste management and contributes to public

apprehension about the effectiveness of current practices." The letter also stated that a hospital could classify between five and seventy percent of its wastestream as infectious depending on the criteria used (Shumaker 1990). Throughout this report, the term infectious waste is used as this is the term that is used by the EPA.

The EPA defines infectious waste as "a waste capable of producing an infectious disease." The definition further requires a consideration of factors necessary for induction of disease. These factors include:

a) presence of a pathogen of sufficient virulence

b) dose

c) portal of entry

d) resistance of host

Table II Comparison of EPA and CDC Categories of Infectious Waste

CDC Recommended Categories of Infectious Waste
Microbiological laboratory waste
Pathology waste
Blood specimens and blood products
Sharps
Isolation waste
EPA Recommended Categories of Infectious Waste
Isolation waste
Cultures and stocks and associated biologicals
Human blood and blood products
Pathological waste
Contaminated sharps
Contaminated animal carcasses, body parts and bedding
Wastes from surgery and autopsy
Contaminated laboratory waste
Dialysis unit waste
Contaminated equipment

Italicized items are optional under the EPA guidance

The EPA summarizes this definition with the statement: "Therefore, for a waste to be infectious, it must contain pathogens with sufficient virulence and quantity so that exposure to the waste by a susceptible host could result in an infectious disease"(EPA 1990).

Guidelines for recommended categories of infectious waste are published by both the EPA and the Centers for Disease Control (CDC). Table II provides a comparison of these recommended categories among the agencies. The Joint Commission on the Accreditation of Healthcare Organizations simply states in their accreditation standards that there should be a program for managing infectious wastes and that the hospital must determine which wastes are infectious. Each of these guidelines leave a considerable amount of decision and authority to the healthcare facility in determining what items will be considered to be infectious.

3.1 Types of Infectious Wastes (EPA Guidelines)

In describing the types of infectious waste listed above, the EPA Guide for Infectious Waste Management provides the following definitions (EPA 1991):

Isolation Wastes- Wastes generated by hospitalized patients who are isolated to protect others from communicable diseases. At a minimum, wastes from patients with diseases considered communicable and requiring isolation as defined by the CDC, should be considered infectious wastes.

Cultures and Stocks of Infectious Agents and Associated Biologicals- All cultures and stocks of infectious agents should be designated as infectious wastes because of high concentrations of pathogenic organisms typically present in these materials. Included in this category are specimen cultures from medical and pathological laboratories, cultures and stocks of infectious agents from research and industrial laboratories, wastes from the production of biologicals, and discarded live and attenuated vaccines. Also, culture dishes and devices used to transfer, inoculate, and mix cultures should be designated as infectious wastes.

Human Blood and Blood Products- All waste human blood and blood products (such as serum, plasma, and other blood components) should be managed as infectious waste.

Pathological Wastes- Pathological wastes consist of tissues, organs, body parts and body fluids that are removed during surgery and autopsy. All pathological wastes should be considered infectious because of the possibility of unknown infection in the patient or corpse.

Contaminated Sharps- All discarded sharps (e.g., hypodermic needles, syringes, pasteur pipettes, broken glass, scalpel blades) which have come into contact with infectious agents during use in patient care or in medical, research, or industrial laboratories present the double hazard of inflicting injury and inducing disease. These wastes should be managed as infectious wastes. All sharps used in patient care should be considered infectious wastes because of the possibility of undiagnosed blood-borne diseases (e.g., hepatitis B and AIDS).

Contaminated Animal Carcasses, Body Parts, and Bedding- This infectious waste category includes the contaminated carcasses, body parts and bedding of animals that were intentionally exposed to pathogens in research, in the production of biologicals, or in the in vivo testing of pharmaceuticals.

Miscellaneous Contaminated Wastes (Optional)- The following wastes are not designated as infectious waste by the EPA. But, in light of the potential hazards posed by these wastes, a determination to manage these wastes as "infectious" should be made by a responsible authorized person at the facility. The Agency recommends, however, that wastes from patients known to be infected with blood-borne disease be managed as infectious waste.

- Wastes from surgery and autopsy
- Contaminated laboratory wastes

- Dialysis unit wastes
- Contaminated equipment

It should be noted that while waste such as feces and urine from isolation patients is considered to be infectious waste, the EPA feels that disposal to the sanitary sewer provides an adequate level of treatment for the waste (EPA, 1991). However, when feces or urine is not deposited by the patient directly to the sewer system, as in the case of accidental spills or when a bed-pan is used, the waste must be cleaned up and disposed of as infectious waste. This still may include disposing of the bulk of the feces or urine to the sewer system. Materials used to clean up the spill or other materials which come in contact with feces or urine are to be considered infectious waste and if these materials are not suitable to be flushed or otherwise released to the sewer system they must be handled by an alternative method of infectious waste disposal.

Because of the high concentrations of infectious agents potentially present in cultures and stocks of infectious agents and associated biologicals, all cultures and devices associated with cultures should generally be treated as infectious waste. This is necessary because once the item is discarded it is difficult to determine whether it was discarded as a non-infectious item or it was an infectious item which was incorrectly disposed of as non-infectious waste.

3.2 Types of Infectious Waste (BUMED Guidelines)

The Navy defines infectious waste in Bureau of Medicine and Surgery Instruction 6280.1 (BUMEDINST 6280.1) dated 25 March 1991. The definition appears to based on the EPA guidelines, however, there are several differences. Rather than listing types or categories of infectious waste, the naval definition lists "examples" of infectious waste. These examples tend to generally follow the EPA classifications, however, the use of the word "examples" leads to an even looser, more poorly defined classification system than that used by the EPA guidelines. Military personnel typically remain in one job assignment for a period of three years or less. Because of this great transition of naval personnel over large

geographic and regulatory areas, a consistent Navy-wide definition of infectious waste is required. The BUMED definition for infectious waste is shown below in italicized print. Following each section of the definition, is commentary in normal print, on that section.

a. *Definition. Infectious waste is liquid or solid waste that contains pathogens in sufficient numbers and with sufficient virulence to cause infectious disease in susceptible hosts exposed to the waste. Examples:*

"Examples" implies an open set of items to be considered infectious, rather than a well defined classification system for each type of infectious waste. The classification system could still include a miscellaneous category which would allow the particular healthcare facility to include additional items based on professional judgement and a more site specific risk assessment. The framework used in the EPA Guidelines could be used with the Bureau of Medicine and Surgery making a navy wide decision on the optional categories or by delegating this decision to the individual healthcare facility. In any case, the decision of optional or miscellaneous categories should not be left to the healthcare worker as this leads to either the generation of excessive infectious waste or the opposite case of the acceptance of excessive risk.

(1) *Microbiology wastes including cultures and stocks of etiologic agents containing microbes that, due to their species, type, virulence, or concentration are known to cause disease in humans. Examples include specimens from medical and pathology laboratories, discarded live vaccines, wastes from production of biologicals, cultures and stocks of infectious agents from clinical research and industrial laboratories, and disposable culture dishes and devices used to transfer, inoculate, and mix cultures.*

All cultures and stocks of infectious or etiologic agents should be treated as infectious waste. This definition causes a decision to be made regarding species, type, virulence and concentration before the item is considered infectious. Additionally, once the culture or stock is discarded it becomes difficult to determine whether it should have been treated as

infectious waste. At minimum, this will cause confusion and unrest with personnel who dispose of the waste and in the worst case it is not protective of human health and the environment if the item really should have been considered infectious.

> *(2) Pathological wastes include human tissues and organs, amputated limbs or other body parts, fetuses, placentas, and similar tissue from surgery, delivery, or autopsy procedures. Animal carcasses, body parts, and bedding exposed to pathogens are also included in this category.*

In the literature, animal carcasses, body parts and bedding are handled as a separate category and the definition usually is applied only to animals which have been intentionally exposed to pathogens in research or testing of pharmaceuticals (EPA 1991, Reinhardt and Gordon 1991). Carcasses and body parts can be treated as pathological waste, however, bedding is not classified as pathological waste and often is not effectively treated by the same methods as pathological waste. The insulating qualities and high moisture content of such bedding may make effective steam sterilization or complete combustion difficult (Reinhardt and Gordon 1991).

> *(3) Liquid waste human blood, products of blood, items saturated or dripping with human blood, or items that were saturated or dripping with human blood that are now caked with dried human blood, pleurevacs, and hemovacs. (Absorbent materials, containing small amounts of blood or body fluids and discarded products for personal hygiene such as diapers, facial tissues, and sanitary napkins are not considered infectious.)*

While this definition appears consistent with the new OSHA regulation on blood-borne pathogens, both regulations leave room for interpretation regarding degree of saturation. This is evident in the current OSHA citing of Naval Hospital in California for disposing an item containing dried blood (Cockram, 1992). In this case, there is a discrepancy between the judgement of the OSHA inspector versus the hospital in what constitutes saturation with

blood. Clearly, better guidance is required on this matter so that the "gray area" in determining infectious qualities may be reduced. However, from the standpoint of waste reduction, it has been my observation that items which contain blood and fall into this gray area do not constitute a large percentage of the waste and therefore, if there is doubt, the item should be handled as infectious.

> *(4) Sharps, including hypodermic needles, syringes, scalpel blades, Pasteur pipettes, specimen slides, cover slips, glass petri plates, and broken glass potentially contaminated with infectious material.*

All sharps used associated with healthcare should be discarded as infectious sharps in an approved sharps container regardless of the potential that the sharp is actually contaminated. If a clean, unused syringe is disposed of in a normal trash receptacle and later someone handling that trash is injured by that sharp, it is difficult to determine whether the sharp was contaminated.

> *(5) Medical wastes from isolation rooms are often defined as infectious waste. However only those items which were contaminated or likely to be contaminated with infective material are infectious waste. Refer to CDC's, "Guidelines for Isolation Precautions in Hospitals" for identification of material likely to be infective.*

In general, inclusion of isolation wastes in an infectious waste policy presents problems and in fact only twenty five states have included it in their definitions (Shumaker, 1990). The state of Washington described reasons for exclusion of isolation wastes in the following excerpt from the Washington State Infectious Waste Project (Shumaker, 1990):

> *"A weakness with this system is the need for an infectious disease diagnosis, which is often difficult to determine. People with specific infections may shed the causative microorganisms whether diagnosed or not, or whether at home or in a medical facility. Many people never exhibit signs of overt infectious*

disease, yet may be chronic carriers of an infectious disease agent. For these reasons the CDC is urging healthcare professionals to consider every patient as a potential source of infection and practice "universal precautions;" a system designed to protect health care professionals from potential infection from any patient, with or without a diagnosed infectious disease. The CDC also cautions that the universal precautions system was developed specifically for health care worker protection, and not to be applied to waste disposal.... There is no evidence to suggest that isolation wastes poses any more infection hazard than general waste."

The conflict between universal precautions practices and prudent infectious waste disposal practices is a common source of confusion among healthcare workers. One case that occurred at Naval Hospital Camp Pendleton points out this confusion. In a random inspection of red bags in a housekeeper's cart, I observed several bags containing nothing but surgical masks, most of which appeared to be unused. These red bags were traced to an isolation room where there was a patient that was potentially infectious but had not yet been diagnosed. Each worker that entered the room put on a mask and upon leaving the room discarded the mask in the red bag which was placed immediately outside the doorway. In following universal precautions it was prudent for the worker to wear the mask, however, I could not find logic in disposing of the mask as infectious waste. If the mask became infectious waste in the brief period in the room, what about the clothing worn by the worker? What about the dishes that the patient was served meals on? What about the newspaper or magazine the patient was reading? The answer is that none of these items are treated as infectious waste unless they contain blood or other bodily fluids from the patient. The masks were treated as infectious waste purely because of the misunderstanding between universal precautions and waste management policy. Since that incident, Naval Hospital has been progressive in attempting to train personnel in this area, however, similar situations continue to occur with the constant turnover of personnel (Murphy, 1992). A more precise definition of isolation wastes would help to reduce this situation. Also, reference to CDC guidance on universal precautions, which does not necessarily apply to waste management practices leads

to confusion in establishing waste management policy.

It can be argued that a Navy-wide instruction must be kept general because state and local regulations vary widely. However, the classifications of infectious waste should be uniform and well defined throughout the Navy with the requirement and delegation of authority such that each hospital manage each type of waste in accordance with state and local regulations.

3.3 Hazardous Wastes

A solid waste is classified as hazardous if it meets any of following four conditions (40 CFR Part 261):

(1) Exhibits, on analysis, any of the characteristics of a hazardous waste

(2) Has been named as a hazardous waste and listed

(3) Is a mixture containing a listed hazardous waste and a non-hazardous solid waste (unless the mixture is specifically excluded or no longer exhibits any of the characteristics of hazardous waste)

(4) Is not excluded from regulations as a hazardous waste.

The characteristics of a hazardous waste which are referred to in (1) above are:

Ignitability

Corrosivity

Reactivity

Toxicity.

Definitions and criteria for testing for each of these characteristics are given in 40 CFR, Sections 261.20 - 261.24. The generator of a solid waste is responsible to determine if that waste exhibits any of the characteristics of a hazardous waste (Loehr, 1991). Currently, carcinogenicity, mutagenicity, bioaccumulation potential and phytotoxicity are not included in the characteristics of a hazardous waste. This is due to the difficulty in measurement and skill required to determine if these characteristics are exhibited by a waste and because of the generator responsibility for determination of exhibition of the characteristics (Loehr, 1991).

Wastes which are considered carcinogenic, mutagenic or phytotoxic can be classified as hazardous if they are listed hazardous wastes.

In addition to the characteristics, there are three lists that were developed by the EPA which lead to the classification of a waste as hazardous:

(1) Non-specific source wastes (40 CFR 261.31)- These are generic wastes, commonly produced by manufacturing and industrial processes.

(2) Specific source wastes (40 CFR 261.32)- This list contains wastes from specifically identified industries.

(3) Commercial chemical products (40 CFR 261.33 (e) and (f))- This list consists of commercial chemical products, or manufacturing chemical intermediates.

The EPA places wastes on these lists if they:

(a) Exhibit one of the four characteristics of a hazardous waste

(b) Meet the statutory definition of hazardous waste (defined by Congress in Section 1004(5) of RCRA; see section 4.1 of this report)

(c) Are acutely toxic or acutely hazardous

(d) Are otherwise toxic.

A detailed discussion of hazardous wastes generated at naval medical facilities is beyond the scope of this report, however, it is important to recognize that hazardous wastes are generated and must be managed separately from the infectious wastes. Hazardous wastes that are typically found in medical facilities are shown in Table III (EPA, 1991). In addition

Table III Hazardous Wastes Typically Found at Medical Treatment Facilities

Acetone	Ethyl alcohol	Petroleum ether
2-Butanol	Heptane	2-propanol
Butyl alcohol	Hexane	Sec-butyl alcohol
Cyclohexane	Methyl alcohol	Tert-butyl alcohol
Diethyl ether	Methyl cellosolve	Tetrahydrofuran
Ethyl acetate	Pentane	Xylene

to these wastes, several antineoplastic drugs are listed on the commercial chemical products

list as hazardous wastes. Antineoplastic drugs are addressed separately in the following section of this report.

As with any large commercial facility, there are also various hazardous wastes that can be generated by the facilities maintenance, construction or transportation operations of the hospital. For example, if the hospital removes a PCB containing transformer, hazardous waste is generated. However, these wastes are not considered to be medical waste. The infectious waste stream must be monitored to ensure that hazardous wastes are managed in accordance with all federal, state and local regulations and not disposed of as infectious wastes.

3.4 Antineoplastic Drugs

Antineoplastic drugs, used in the treatment of cancer, exhibit mutagenic, teratogenic and/or carcinogenic effects in man and animals (Reinhardt and Gordon 1991). These waste are disposed of in the form of unused portions of containers, protective clothing contaminated with the substance and residuals in apparatus used to dispense the drugs. Table IV shows the drugs which are listed under RCRA as hazardous wastes.

Table IV Antineoplastic Drugs Regulated As Hazardous Wastes By RCRA

Drug	Hazardous Waste Number
Mitomycin C	U010
Chlorambucil	U035
Cyclophosphamide	U058
Daunomycin	U059
Malphalan	U150
Streptozotocin	U206
Uracil mustard	U237

These substances do not exhibit characteristics of hazardous wastes but are listed as discarded chemical products. The EPA only regulates these drugs as hazardous when they are in the

form of waste commercial products or spills of commercial products. Waste commercial products refer to unused portions which are discarded in source containers and not to residual amounts of the substance that are left in dispensing devices or other items contaminated with the substance. However, some states such as California do regulate the drugs as hazardous wastes no matter what form the substance is in. This leads to confusion when the waste becomes a combination of two types of waste. For example a sharp which is contaminated with an antineoplastic drug in California must be managed as a hazardous waste and can not be discarded in the same manner as other sharps.

Another problem with antineoplastic drugs which are regulated as hazardous waste is that the hospital must obtain an EPA hazardous waste generator identification number and must not store the waste for more than 90 days. Infectious waste disposal contractors such as Browning Ferris Industries Inc. (BFI) are usually permitted to handle the substance. However, if the hospital does not have a generator ID number, the contractor may not legally pick up the waste. Additionally, when waste disposal contracts are written, they must address hazardous waste specifically and separately from infectious waste or the contractor may refuse to pick up the waste without a contract modification. These factors may cause delays in disposal which will result in the hospital storing the waste for longer than 90 days which is in violation of RCRA. This exact situation is what occurred at Naval Hospital Camp Pendleton upon closure of the medical waste incinerator.

Antineoplastic drugs are not mentioned in BUMEDINST 6280.1. Typically, the person responsible for infectious waste disposal and for the development and approval of contract specifications for such disposal in a Naval Hospital is a Civil Engineer Corps Lieutenant or Lieutenant Junior Grade. This position typically rotates every two to three years. It is highly unlikely that a civil engineer entering this position has ever heard the term antineoplastic drugs let alone know whether or not it is a hazardous waste. Therefore, in order to avoid serious violations of law it is prudent to define and discuss antineoplastic drugs in BUMEDINST 6280.1 as they are presented in this section.

4.0 Regulations and Guidelines Applicable to the Handling and Disposal of Infectious Medical Waste

The management of infectious waste is governed by many regulations, guidelines, standards and organizational and institutional policies. Federal, state and local governments all issue regulations which pertain to infectious waste. These regulations are enforceable by law and carry both civil and criminal penalties. Guidelines are also issued by various levels of government and by professional organizations. Guidelines are not enforceable by law, however, they are issued to promote uniform and prudent management of infectious waste. Also, guidelines issued by one governmental or professional entity often serve as the basis for regulations which are issued by another entity. Standards are also not enforceable by law and are normally issued by an organization that provides a widely recognized certification such as the Joint Commission on the Accreditation of Healthcare Organizations. These certifications have become so important to healthcare facilities that the standards to achieve such certification are usually treated as if enforceable by law. In Navy medicine there are also navy policies regarding infectious waste which are issued in the form of Naval Instructions. In addition to establishing Navy-wide policy for infectious waste management, the instructions delegate authority and responsibility down the chain of command so that local or institutional policies can be set which comply with local regulations.

The following sections of this chapter highlight the major regulations, guidelines, standards and policies that currently apply to infectious waste management within the Navy. The intent of these sections is to provide reference to and discuss the applicability of the regulations. While the Navy regulations and policies are discussed in some detail and critical commentary is provided, it is beyond the scope of this report to provide the detailed requirements of all of the regulations. It is important to realize that the regulation of infectious waste is a very dynamic area of law and therefore persons involved in the management of infectious waste must constantly remain current with all regulations that apply to their facility. As an example of the rapidly changing arena of regulations, one researcher reported that in 1986 only fifty-seven percent of the states had infectious waste regulations or

bills pending and by the spring of 1989, ninety percent of the states had regulations or bills pending before their legislatures to establish infectious waste regulations (Shumaker, 1990). Additionally, the results from the EPA's two year demonstration program, which was established by the Medical Waste Tracking Act of 1988, and increasing public awareness caused by fear of the spread of AIDS are causing a flood of new state regulations and changes to existing state regulations regarding infectious waste.

4.1 The Resource Conservation and Recovery Act of 1976 (RCRA)

In 1978, the EPA issued proposed regulations allowing it to regulate infectious waste as a hazardous waste (Federal Register, December 18, 1978). Section 1004(5) of RCRA defines the term "hazardous waste" as a *"solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical or infectious characteristics may:*

(A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or

(B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed."

However, the EPA has never issued final regulations which would cause infectious wastes to be managed as hazardous wastes. This is due to the lack of evidence that the disposal of infectious wastes pose any greater risk to human health and the environment than general domestic waste and that the risks are mainly occupational in nature (EPA, 1991). In fact, even during the summer of 1988 the EPA stated that the medical waste problem is regional and should be handled as part of municipal solid waste and not as a hazardous waste under RCRA (EPA 1988). During the same year, the Medical Waste Tracking Act (MWTA) of 1988 was passed. The MWTA amended RCRA to add Subtitle J which established a two year demonstration program for tracking medical waste in several states. The MWTA will

be discussed separately in the following section of this report.

With the exception of the sections of RCRA that were amended by the MWTA, RCRA applies only to medical waste which is non-infectious solid waste and medical waste which is hazardous waste. Medical wastes which are hazardous are discussed in Section 4.3 Hazardous Wastes. Medical wastes which are non-infectious and non-hazardous do not require any special management other than that required under RCRA by Subtitle D - Solid Waste.

4.2 The Medical Waste Tracking Act (MWTA) of 1988

In response to the crisis caused by the beach washups during the summer of 1988, Congress passed the MWTA. The MWTA amended RCRA and required the EPA to establish the demonstration program and to report to Congress on several areas of medical waste management. The EPA met the requirements of the MWTA by issuing 40 CFR Part 259 which established standards for the tracking and management of medical waste. These standards apply only to "Covered States" for the duration of the program (June 22, 1989 to June 22, 1991). The regulations define "Covered States" as those States that are participating in the demonstration medical waste tracking program and includes: Connecticut, New York, Rhode Island, and Puerto Rico. Any other State is a Non-Covered State. Under the MWTA, the EPA is further required to use data from the demonstration program to evaluate whether to make the regulations permanent and whether to extend them to all states. To date, there has been no final decision promulgated to this regard. Although the demonstration program is over, the Covered States have implemented their own regulations which meet or exceed the requirements of the MWTA.

The major thrust of the MWTA is to provide standards for cradle to grave tracking and management of medical waste and to evaluate the effectiveness and cost/benefit relationships of these standards. The standards set forth in 40 CFR Part 259 provide detailed requirements for the generation, labeling, packaging, transportation, storage, treatment and ultimate disposal of regulated medical waste. The EPA estimated that the cost of implementation of the requirements of the MWTA would be 24 million dollars over the

two year period (EPA, 1991). The EPA made preliminary estimates that monetary damages in New York, New Jersey and Connecticut due to mismanaged medical waste were in the range of 30 million dollars during the summers of 1987 and 1988 when the beach washups occurred (EPA, 1991). This figure is mainly associated with the economic impacts of beach closures in these states (i.e. beach fees and associated tourism revenues). In September of 1991 the New York Times reported that the beach closings in New Jersey and New York during the 1988 washups cost the states about 1.5 billion dollars in lost revenue (Lyall, 1991). Because most of the beach washups were finally attributed to home healthcare, which is not regulated by the MWTA, it can not be assumed that the requirements of the MWTA will prevent the beach closures from occurring. In fact, on August 31, 1991, the beach at Jacob Riis Park in Queens, New York was closed due to the appearance of approximately 500 syringes on the beach (New York Times, September 2, 1991). This incident was originally reported as "the first medical waste found on Federal shores since the crackdown on illegal dumping in 1988". Later it was reported that the syringes were dumped on the beach rather than washed up and that it was the first New York or New Jersey beach closure since the 1988 closures.(New York Times, September 11, 1991). The article goes on to describe that small washups of medical waste continue to occur along with regular trash washups, only now the waste is simply cleaned up rather than being reported to the media. Also stated is that "in New York and New Jersey, beach operators follow new guidelines for handling waste, so that beaches that would have been closed in 1988 remained open this summer". Perhaps since household waste is not "regulated medical waste" under the MWTA, a determination is being made right on the beach that medical related items that washup with normal trash are not necessarily medical waste.

Opposition to a federal regulation with the scope of the MWTA has been mostly based on cost of the tracking program. The vast majority of national attention to the mismanagement of medical waste has been associated with beach washups. States which do not have coastlines do not have this problem and the costs associated with the tracking program exceed the benefits that would be obtained. In 1990, Mr. L. D. Thurman, P. E., the Associate Commissioner for Environmental and Consumer Health Protection in Texas, stated that "the increasing expense involved in further regulation of the industry threatened

substantial harm to those small hospitals in Texas that are barely hanging on now" (Shumaker, 1990). The medical wastes problems that apply to all states are those associated with the protection of healthcare and sanitation workers. These problems are not influenced so much by the tracking of the waste but are a result of packaging, storage, treatment and disposal practices. One researcher suggested that federal regulation should consist of standards that apply only to packaging, storage, treatment and disposal and that if tracking standards are included, they should include an "opt in" procedure for states that have had problems with mismanagement of the waste (Shumaker, 1990).

4.3 Toxic Substances Control Act (15 USC Chapter 53; Subchapter I)

The Toxic Substances Control Act (TSCA) has limited applicability in the arena of medical waste management and appears to have no applicability to infectious waste management. The intent of the TSCA is to regulate the development, manufacture, distribution in commerce and disposal of chemical substances and mixtures. In its definition of chemical substances, TSCA specifically excludes: "any food, food additive, drug, cosmetic or device when manufactured, processed or distributed in commerce for use as a food, food additive, drug, cosmetic or device." Therefore, items which occur in a medical wastestream which meet the exclusion would not be regulated by TSCA. There could be chemicals such as disinfectants or cleaners in the medical wastestream which do not meet the drug exclusion and could be regulated by TSCA. In regard to disposal of such items, it appears that the only applicable portion of TSCA is found in **§ 2605 Regulation of hazardous chemical substances and mixtures** of the Act. This section states:

> *"If the Administrator finds that there is a reasonable basis to conclude that the manufacture, processing, distribution in commerce, use, or disposal of a chemical substance or mixture, or that any combination of such activities, presents or will present an unreasonable risk of injury to health or the environment, the Administrator shall by rule apply one or more of the following requirements to such substance or mixture to the extent necessary to protect adequately against such risk using the least burdensome requirements:*

(3) A requirement that such substance or mixture or any article containing such substance or mixture be marked with or accompanied by clear adequate warnings and instructions with respect to its use, distribution in commerce, or disposal or with respect to any combination of such activities. The form and content of such warnings shall be prescribed by the Administrator."

Thus, certain non-drug substances which may appear in the waste stream may have specific disposal requirements as established by the TSCA. These requirements should be marked on packaging or in Material Safety Data Sheets (MSDS) which accompany the product.

Because of the large number of persons discarding wastes in a healthcare setting, it is prudent to identify items that have TSCA requirements at the point of purchase or entry into the facility. Once the products are identified, proper training in regard to disposal requirements can be given to personnel who use such products and monitoring of disposal practices can be done. Also, substitute products which are non-toxic may be identified to replace the toxic chemicals.

It is possible that chemicals which are regulated by the TSCA could be combined with an infectious waste. In that event, it would be best to check with the regional EPA office or local agency which regulates waste disposal in order to determine the proper method by which to handle the waste.

4.4 Occupational Safety and Health Act (§ 1910.1030 Bloodborne Pathogens)

In December 1991, the Occupational Safety and Health Act was amended to include Section 1910.1030 Bloodborne Pathogens. The section is applicable to all occupational exposure to blood or other potentially infectious materials as defined later in the section. The regulation was passed in an effort to protect healthcare and laboratory workers from the Hepatitis B virus, AIDS virus and other pathogenic organisms that are present in blood. While the regulation does describe packaging, storage and handling requirements for infectious materials and regulated waste, it does not expressly apply to treatment and disposal of infectious waste and was not intended to serve as a policy for infectious waste management beyond the workplace. In fact, the regulation only addresses workplace hazards

at the generation point of infectious wastes. That is, it does not address workplace hazards from bloodborne pathogens that may be present at an off-site infectious waste treatment location or at a sanitary waste treatment plant.

OSHA defines regulated waste in this section as:

> *"liquid or semi-liquid blood or other potentially infectious materials; contaminated items that would release blood or other potentially infectious materials in a liquid or semi-liquid state if compressed; items that are caked with dried blood or other potentially infectious materials and are capable of releasing these materials during handling; contaminated sharps; and pathological and microbiological wastes containing blood or other potentially infectious materials."*

However, in addressing the disposal of regulated waste, the regulation only states that:

> *"Disposal of all regulated waste shall be in accordance with applicable regulations of the United States, States and Territories and political subdivisions of States and Territories."*

Therefore, from a waste management standpoint, the only impact of the regulation is to provide packaging, labeling, storage and handling requirements while the waste is in the workplace in which it was generated, and to define some items that must be included as regulated waste. As described in chapter 3 of this report, there has been some controversy and confusion in regard to the quantity of blood an item must contain to be considered infectious. This has resulted in at least one Naval Hospital receiving a citation during an OSHA inspection for improper disposal of a regulated waste (Sorgen, 1992).

4.5 The U. S. Public Vessel Medical Waste Anti-Dumping Act of 1988

The U. S. Public Vessel Medical Waste Anti Dumping Act of 1988 provides amendments to the Marine Protection, Research and Sanctuaries Act of 1972 and was enacted after the beach washups of medical waste during the summer of 1988. The Act, as described in the Navy's Environmental and Natural Resources Program Manual, specifically prohibits the disposal of potentially infectious medical waste into ocean water unless:

a. *The health and safety of individuals is threatened*

b. *During time of war or declared national emergency*

c. *The waste is disposed of 50 nm* (nautical miles) *from land and is steam sterilized, properly packaged, and sufficiently weighted to prevent waste from coming ashore (for submarines; steam sterilization is not required, but waste still must be properly packaged and weighted).* (Source; OPNAVINST 5090.1A)

4.6 Department of the Navy Instructions

Navy policy is issued in the form of Naval Instructions. The Instructions are issued by various levels of command, and carry the name of the issuing organization within the Navy. Hence, a policy issued by the Office of the Secretary of the Navy will be labeled Secretary of the Navy Instruction #### or SECNAVINST ####. The instruction regarding infectious waste management at land based medical treatment facilities is issued by the Bureau of Medicine and Surgery (BUMED) and is BUMEDINST 6280.1. Based on the policy contained in the BUMED instruction, each Medical Treatment Facility issues a corresponding instruction which addresses the site specific aspects of the policy. For example, Naval Hospital Camp Pendleton's instruction regarding infectious waste is NAVHOSPCAMPEN INST 6280.1.

OPNAVINST 5090.1A Environmental and Natural Resources Program Manual implements Navy policy for shipboard medical waste disposal. There is also a draft guidance document entitled Shipboard Medical Waste Guidance, however, it could not be confirmed whether this document has been officially released by Naval Sea Systems Command. BUMED has only been involved in shipboard medical waste management from the standpoint of review of the draft guidance document (Cockram, 1991). A weakness in the management of infectious waste within the Navy is that there is not one organization that is responsible

for medical waste management. Therefore there is not one master policy nor even one uniform set of well defined terms that apply to infectious waste management throughout the Navy.

As well as providing an overview of the applicable Navy regulations and guidance regarding infectious waste, critical commentary of such regulations and guidance is provided in the following sections.

4.6.1 OPNAVINST 5090.1A Environmental and Natural Resources Program Manual

OPNAV INSTRUCTION 5090.1A was issued by the Chief of Naval Operations on October 2, 1990. The purpose of the instruction is:

> *"To discuss requirements, delineate responsibilities, and issue policy for the management of the environment and natural resources for all Navy ships and shore activities."*

The definition for infectious waste is provided in Section 10-3.1 and is in general agreement with the EPA definition of infectious waste with the exception that the optional categories of infectious waste are not included. The EPA definition of infectious waste is discussed in Chapter 4.

In regard to infectious waste management, Section 10-4.5 states that Federal facilities are responsible for compliance with state infectious waste regulations. Section 10-4.5.2 of the instruction refers to the EPA's Demonstration Program required by the MWTA and states that Federal facilities located in any of the demonstration States must comply with EPA regulations.

OPNAVINST 5090.1A provides authority and assigns responsibility to BUMED for the issuance and revision of BUMEDINST 6280.1 Management of Medical Waste. It also requires BUMED to ensure that subordinate commands comply with Federal, State and local and Status of Forces Agreement (SOFA) requirements regarding the identification, generation, handling, storage, transport, treatment and disposal of infectious waste. SOFA's

are defined as agreements on the stationing or operations of forces in a host country. The instruction also tasks commanding officers of shore activities to comply with the infectious waste management procedures specified in BUMEDINST 6280.1 and to provide facilities to receive infectious waste from ships.

Section 10-5 of OPNAVINST 5090.1 establishes Navy policy for solid waste disposal. Infectious waste is by definition a solid waste and therefore Navy policy on solid waste is also applicable to infectious waste. Section 10-5.3 requires that :

"Solid waste management plans shall be developed using the following priority basis:

a. Source reduction

b. Recycling

c. Energy recovery

d. Waste treatment

e. Contained disposal.

Therefore, BUMED is tasked by OPNAVINST 5090.1 to incorporate source reduction, recycling and energy recovery into BUMEDINST 6280.1. These concepts are not adequately addressed in the BUMED instruction, which is discussed in the following section.

Section 10-5.7 of OPNAVINST 5090.1A sets policy for infectious waste management in foreign countries. This policy is that infectious waste shall be managed in substantially the same manner as that in the United States.

Chapter 17 of OPNAVINST 5090.1A is entitled Pollution Prevention Afloat. Section 17-3.7.3 again defines medical waste. The definition in Chapter 17 is essentially the same as the previous definition given in Chapter 10, however, the category of contaminated animal carcasses has been left out. It is presumed that this was done because contaminated animal carcasses are not generated on ships. Even if that is the case, there is no need to redefine the term infectious waste. As discussed in Chapter 3, there is a need for one uniform definition of infectious waste and one uniform set of categories of infectious waste to be used throughout the Navy.

Section 17-5.8 of the instruction provides excellent guidance for shipboard treatment and disposal of infectious waste and general solid waste. The requirements for shipboard

Table V Summary of Infectious Waste Discharge Restrictions

Area	Infectious Wastes
U.S. Internal Waters and Territorial Seas (0 - 3 nm)	Steam sterilize, store and transfer ashore. No discharges. But, see state/local regs.
U.S. Contiguous Zone (3 - 12 nm)	Same as U.S. Internal Waters
12 - 25 nm	Same as U.S. Internal Waters
> 25 nm	Same as U.S. Internal Waters
> 50 nm and High Seas	If potentially infectious waste presents health hazard, steam sterilize, package, weight for negative buoyancy and discharge. No discharge of sharps.
Foreign Countries	The packaging, handling, storage, transport, treatment, and disposal of infectious waste shall be as prescribed by applicable SOFA's.
Comments	All sharps to be disposed of ashore. Plastic and wet materials shall not be incinerated. Other non-infectious medical waste may be disposed of as trash and does not require steam sterilization or special handling. The requirement to steam sterilize prior to disposal at sea does not apply to submarines

disposal of infectious waste are also summarized in Table 17.1. The portion of Table 17.1 which deals with infectious wastes is presented here as Table V. The instruction also specifically requires that unused sharps be treated in the same manner as infectious sharps. This point is important due to the fact that if an unused sharp washes up on a beach it will be difficult to determine that the sharp was unused. Therefore the unused sharp will have the

same impact on public perception as a contaminated sharp. The point is further emphasized in Section 17-6.8, which tasks commanding officers and masters of Navy vessels to "ensure that no medical materials are disposed of in a manner that poses a risk or perception of a risk to the public health and welfare, or to the marine environment."

4.6.2 BUMED INSTRUCTION 6280.1 Guidelines for Management of Medical Waste

BUMEDINST 6280.1, dated 25 March 1991 is the current instruction for the management of medical waste at Medical Treatment Facilities (MTFs) and Dental Treatment Facilities (DTFs). A copy of BUMEDINST 6280.1 is presented in Appendix A. The instruction appears to be written mainly from the point of view of minimizing the occupational risks of infectious waste and is weak with regard to the effective, efficient management of the waste beyond the point of generation. The instruction does not reference the high cost of infectious waste disposal, set policy for, or stress the importance of the minimization or reduction of infectious waste. The following introductory paragraph of the instruction expresses these points:

> *"Limited data suggests that the treatment and disposal of medical waste may be a significant occupational health hazard to health care workers, but does not appear to adversely effect the environment. Recent public awareness and concern, however, has resulted in increased Federal, State and Local regulatory agency interest and response."*

Environmental quality criteria and standards are related to more than just the risk of a human or animal contracting an infectious disease. Aesthetics are a key parameter of environmental quality and therefore improperly managed medical waste does adversely impact the environment. It is argued that this impact is no worse than the impact of normal trash, however, for most of the public, it is much more acceptable to see a soda can on the

beach than to see a syringe. Further, it is not the treatment and disposal of the waste that is an occupational hazard, but, the mismanagement of the waste which is the problem. Data regarding this occupational hazard is no longer limited, as the Center for Disease Control estimates that annually, twelve thousand cases of Hepatitis B infections occur among healthcare workers due to occupational exposure to blood (Washington State, 1989).

As shown in Chapter 2, trackable costs for infectious waste disposal at Navy medical facilities has doubled in four years and there is nothing to suggest that it will not continue to increase. Any effective waste management guidance should stress the importance of waste minimization/reduction. In fact, OPNAVINST 5090.1A requires that in establishing a solid waste management plan, the first priority should be source reduction. The only guidance to this regard comes as paragraph 3, which reads:

> *"Noninfectious Waste Medical waste determined to be noninfectious will be treated as general waste, using currently accepted methods of collection, storage, transport and disposal."*

It would be more appropriate for the guidance to require that a management plan be in effect that monitors the wastestream to ensure that noninfectious materials are not routinely disposed of with infectious waste. The problem of disposal of noninfectious waste as infectious waste is one that requires continuous monitoring and enforcement. When routine monitoring of the red bags at Camp Pendleton began, it was estimated that 50 percent of all red bag waste was clearly noninfectious. Such items as large cardboard boxes used for packaging of medical supplies, newspapers, administrative paperwork, soda cans and lunch papers were commonly found. Less common items included an entire lemon meringue pie, a 2.5 gallon jug of drinking water, bed sheets, hospital gowns and scrubs, and paperwork intended to be destroyed in accordance with privacy act procedures. This does not indicate that Camp Pendleton's management of medical waste was exceptionally poor. I have observed this same phenomena in other hospitals, both military and civilian. In fact, in several trips to an Air Force Hospital in Austin, Texas, during the summer of 1992, it appeared that there was no concern for the high cost of infectious waste disposal. Many offices and exam rooms contained only red bag receptacles and virtually all trash was disposed of as infectious. One red bag was observed to be full of nothing but large sheets of

roll paper which are used to cover the exam table. Upon completion of one patients examination for a wart, the paper was again torn off and disposed of as infectious waste. Even more interesting is the fact that the patient did not even sit on or touch the exam table and that the patient was not even treated but referred to another office.

This very expensive non-segregation of waste is a result of a natural tendency to discard waste in the receptacle that is most convenient and in hospitals red bags are usually very convenient. As another example of this tendency, consider the recycling of aluminum cans in public buildings. If the opening in the recycling containers will accommodate anything more than a 12 ounce can, people will discard whatever trash they have in their hand into that container even though the container is clearly marked for recycled aluminum only.

An additional problem with the statement on noninfectious waste is that it is not correct to state that medical waste which is noninfectious will be treated as general waste, as the waste may be a hazardous waste or a waste which is regulated under TSCA. Medical waste which is hazardous is discussed in Chapter 3.

The only reference cited in the instruction is 29 CFR 1910.132 (a) and (c). This reference is the OSHA Personal Protective Equipment regulation and is not specific to medical waste handling. The bloodborne pathogen regulation (§ 1910.1030) describes the appropriate equipment to be worn when handling infectious waste. Any revision to BUMEDINST 6280.1 should incorporate this bloodborne pathogen regulation as a reference. Additionally, a reference should be provided to the EPA Guide for Infectious Waste Management or to whatever the most current EPA guidance or regulation regarding infectious waste is at the time. OSHA does not have authority to regulate the treatment and disposal of medical waste other than with regard to the occupational hazards of such.

In regard to packaging and handling of infectious waste, the instruction provides some detail. However, packaging materials are described loosely, using terms such as "rigid, puncture resistant" and "leak proof plastic". It would be much more beneficial to provide a reference to a definitive specification such as American National Standards Institute (ANSI) or American Society for Testing and Materials (ASTM).

The instruction's guidance on treatment and disposal includes a table entitled "Table

1, Treatment and Disposal Methods for Infectious Medical Waste". However, the guidance is confusing because the listed types of medical waste do not exactly follow the types of waste as set forth in the definitions. Problems associated with the definitions used to classify infectious waste were described in Chapter 3. Again it is pointed out that the Navy should use a classification system such as used by the EPA. Confusion will be eliminated by a well defined set of waste types even though the treatment of each waste type may differ from state to state. In referring to the table, paragraph f.(2) states "Treatment must follow recommended guidelines in table 1. However, more confusion is generated by the first footnote of table 1 which states, "However, alternative treatment and disposal methods may be used if effective and environmentally sound." The instruction does not suggest who is to determine the effectiveness or environmental soundness of the alternative methods of treatment. A better policy would be to provide a table of preferred methods of treatment for each of the EPA types of infectious waste and to allow the use of alternative methods when such methods are in compliance with Federal, State and Local regulations and upon approval of the Bureau of Medicine and Surgery.

4.6.3 Shipboard Medical Waste Management Guidance

The Shipboard Medical Waste Guidance Document was written by the Naval Sea Systems Command (NAVSEA). A final copy was not able to be obtained, however, the draft copy dated April 1991 appears to be fairly complete. The document is intended to provide further amplification and detail of the shipboard medical waste guidance provided in OPNAVINST 5090.1A. It is also apparent that parts of the document follow BUMEDINST 6280.1 fairly closely. Portions of the guidance that are applicable to infectious waste management ashore or afloat are taken from the BUMED instruction. The parts which are specific to shipboard medical waste have been added by NAVSEA. Ironically, the parts written by NAVSEA provide more detailed guidance and better management policy than the parts taken from the BUMED instruction. For example, the description of plastic bags to be used for infectious waste is taken from the BUMED instruction and reads as follows:

"Plastic bags should be of sufficient quality so that only one bag is needed for most

situations"

This practice of using non-definitive specifications was described in the previous section. For comparison, the section on shipboard incinerators, which was written by NAVSEA reads:

> *"The MIL-SPEC incinerator (MIL-I-15650E) used by the Navy is an excess air, single chamber incinerator...."*

The use of a reference to a standardized specification leaves no room for confusion in finding the proper material or equipment to be used. Both the BUMED instruction and the NAVSEA document should be rewritten to incorporate standard specifications wherever material or equipment is referenced. In cases where a particular state may have a more rigid requirement, a statement can be added that indicates to meet or exceed the referenced specification in order to comply with state regulations.

Guidance on segregation of wastes is more emphatic than that contained in the BUMED instruction. Paragraph III.A(3) states that "Selective segregation of medical waste will reduce significantly the quantity of infectious waste that must be processed and stored onboard." Obviously, the logistical considerations of life onboard ship require that personnel be more conservative in producing waste. This is reflected in the stronger emphasis on segregation of infectious from non-infectious waste.

The guidance document also contains a table of shipboard infectious medical waste requirements and a table of other (non-infectious) shipboard medical waste requirements. These tables provide adequate logistical detail, however, reference to standardized specifications for waste packaging is missing. Inclusion of these specifications would enhance the usefulness of the tables.

4.7 State Regulations

A discussion of each states infectious waste regulations is beyond the scope of this report. Additionally, the state regulations are changing so fast that the accuracy of literature on the subject becomes questionable over the period of several months. Persons responsible for the management of infectious waste must stay current with infectious waste legislation in

their particular state and in any states to which their waste is shipped. This Section provides a few brief comments on current and future areas of state infectious waste regulation. Infectious waste is currently regulated by 44 states (American Medical News, May 18, 1992). These regulations vary widely from state to state, with the most stringent regulations occurring in New York and New Jersey. These states have issued regulations which exceed the requirements of the MWTA demonstration program. In December, 1991, the State of New York issued regulations that establish minimum standards for the operation and licensing of medical waste treatment technologies. The regulations were established in response to the increase in the use of alternative technologies after new clean air regulations resulted in the shut down of most infectious waste incinerators. The New York regulations are expected to serve as a model for several other states (Modern Healthcare, December 9, 1991).

As of July 1992, no states have implemented regulations for household infectious wastes. However, these wastes have been blamed as the ultimate cause of many of the beach wash-ups. One researcher pointed out that a city such as New York with over 100,000 diabetics using insulin daily would generate 35 million syringes annually (Sugrue, 1991). Regulation of household infectious waste may be the next frontier in infectious waste management. One approach to this could be to require the issue of small sharps containers when prescriptions are filled and to require the patient to turn in the containers prior to the next refill. The small sharps containers are currently available and are used by healthcare professionals who provide treatment in patients homes or place of business. In Naval Hospitals, prescriptions are usually filled from the pharmacy within the hospital. It would be fairly simple to receive the home healthcare sharps containers at the pharmacy and dispose of them with the remainder of the hospital generated sharps. Initiation of this program on a voluntary basis would at minimum offer concerned patients with a responsible method of disposal of their syringes.

4.8 Proposed Federal Legislation

On June 22, 1992, American Medical News reported that new regulations are contained in legislation sponsored by Senators Baucus (D. Mont.) and Durenberger (R.

Minn). The proposed regulations would redefine the definition of medical waste to include "every item used in a doctor's office for diagnoses or treatment." These regulations appear to be irrational, as items which pose no risk to public health would become regulated while more than 1 billion sharps generated annually through home healthcare would remain unregulated. The main proponents of the legislation are reported to be the sponsors and the infectious waste management companies. The article also reported that the interim reports regarding the MWTA demonstration program from the EPA and the Agency for Toxic Substances and Disease Registry (ATSDR) have not indicated the need for such regulation. The final EPA report on the demonstration program is due to Congress in the fall of 1992.

5.0 Infectious Waste Handling, Packaging and Storage

Infectious waste handling, packaging and storage requirements are dependent upon several factors, which include:

- Federal, State and local regulations
- Type of infectious waste
- Method of infectious waste treatment to be used.

This chapter provides a description of some of the requirements and techniques used in the handling, packaging and storage of infectious waste. As with all regulations pertaining to infectious waste, the regulations specific to this chapter vary widely from State to State. However, OSHA's new regulation on bloodborne pathogens has recently resulted in some consistency on a federal level especially in regard to handling and packaging of the waste.

5.1 Handling

Handling of infectious waste occurs during segregation at the point of generation, packaging and collection of the waste, and treatment and disposal. Segregation serves to prevent contamination of larger quantities of non-infectious waste, ensure that infectious waste is treated in a manner that minimizes danger to human health and the environment, reduce the cost of waste treatment practices by preventing general waste from being treated with the high cost methods used for infectious waste, and to ensure that the various types of infectious waste are handled and treated in an appropriate manner.

Proper handling techniques for infectious waste are designed to minimize the occupational exposure to the infectious pathogens contained in the waste. Exposure to pathogens requires that the pathogen have a portal of entry into the person handling the waste. Possible portals of entry for substances into the body include penetration, inhalation, ingestion and absorption through the skin. With pathogenic organisms, the greatest risk of exposure is when puncture of the skin occurs with a contaminated sharp object. This is why

the most stringent regulations apply to the handling of sharps. Exposure through inhalation can occur when pathogens are present in aerosols or dust that is disturbed when waste is handled. Ingestion of pathogens can occur when a person eats or touches the mouth or nose with hands after contact with infectious waste, or when infectious liquids are splashed directly into the mouth or nose. It is not expected that absorption of pathogens through the skin is a high risk, however, it is possible that this form of infection can occur through mucous membranes such as the eyes.

The most prevalent regulation of infectious waste handling procedures is contained in OSHA's bloodborne pathogen regulation (29 CFR 1910), which was discussed in Chapter 3. The regulation includes such items as:

- Engineering and work practice controls
- Required personal protective equipment
- Housekeeping requirements
- Employee training requirements
- Recordkeeping requirements
- Labeling requirements.

Prior to the OSHA regulation, infectious waste handling was regulated mainly by state regulation.

5.2 Packaging

Regulation of infectious waste packaging is still largely controlled through state regulations. The OSHA bloodborne pathogen regulation requires that a standard biohazard symbol be placed on all infectious waste containers. However, the regulation does not describe specific strength requirements for packaging but uses descriptive words such as "puncture resistant" and "leakproof". The

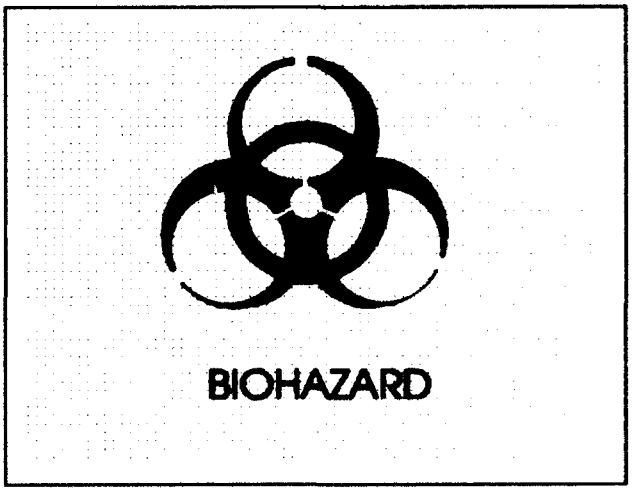

Figure 4 Biohazard Symbol

biohazard symbol required by the OSHA regulation is shown in Figure 4. Labels or packaging are required to be fluorescent orange or orange-red, with lettering or symbols in a contrasting color. Waste that has been decontaminated or treated is not required to be labeled as infectious or biohazardous.

State regulation on package strength varies from the use of adjectives such as "leakproof", "puncture resistant", or "impervious", to the use of specific standards as those established by the American Society for Testing and Materials (ASTM). Some ASTM standards which are used for infectious waste packaging are the "125 pound drop-weight test" or the "165 gram dropped-dart-impact test." Some states have added their own requirements to these standards such as Ohio's requirement for the "water test", in which a bag is required to hold twenty-five pounds of water for 30 seconds (Shumaker 1990). Other requirements include the use of double bagging, in which one bag is placed within another, or the use of a bag inside a corrugated cardboard box. In Chapter 4, it was pointed out as a weakness that Navy policy does not use a standard specification on its packaging requirements. Even though State requirements vary, the Navy should use an available standard specification with a meet or exceed policy for States with more stringent requirements. This would also be useful in ensuring that an adequate waste package is procured for use on ships, which eliminates repackaging requirements when a ship arrives at a port that requires use of a product which meets a standard specification.

5.3 Storage

Storage requirements for infectious waste are also primarily a result of State regulation and vary from State to State. Typically the regulations intend to limit the wastes exposure to rodents and weather, or to limit the time or temperature conditions in which the waste is stored. Exposure to rodents and weather is controlled so that pathogens can not be spread through infection of the rodents, or through rainfall runoff from the waste. Limitations on storage time and temperature are enforced in order to keep the waste from putrefying. Additional regulation is in the form of requirements for locked storage or signs

which indicate that infectious or biohazardous waste is stored within.

Table VI Variation in Infectious Waste Storage Requirements Among Several States

State	Storage Requirement
California	No more than 4 days at temperatures above 32°F or up to Ninety days at temperatures below 32°F
Delaware	Ninety days at temperatures from -4 to -1°F, forty-five days at temperatures up to 45°F and fourteen days at temperatures up to 64°F
Pennsylvania	24 hours at room temperature for blood, body fluids, body parts and cultures and stocks of etiologic agents; Three days at room temperature for infectious wastes other than previously mentioned; Five days if refrigerated and ninety days if frozen
Florida	Thirty days regardless of temperature
New York	Five days regardless of temperature
Arizona	72 hours regardless of temperature

Examples of time-temperature requirements for the storage of infectious waste, imposed by several states, are shown in Table VI. In contrast to the requirements shown in the table some states again use non-specific requirements such as "the waste must be stored in such a manner as to avoid putrefaction of waste." Navy policy states that infectious waste storage should be limited to 4 to 7 days without refrigeration except in States with stricter requirements. This is one of the few areas in which the Navy policy is specific in its requirements. Table VI was compiled from information contained in Infectious Waste: A guide to State Regulation and a Cry for Federal Intervention; as published in Notre Dame Law Review [Vol. 66:555 1990].

As with all areas of infectious waste regulation, it is critical that persons involved with infectious waste management remain current on all Federal, State and local regulations which apply to handling, packaging and storage of infectious waste.

6.0 Infectious Waste Treatment and Disposal Alternatives

There are numerous methods for the treatment and disposal of infectious medical waste. The applicability of these methods for a particular facility depends on such variables as:

- Federal, State or local regulations applicable to treatment and disposal
- Type and quantity of waste generated
- On-site space available for treatment operations
- Availability and cost for landfill disposal of treated wastes.

This chapter discusses the major methods that are currently in use by or available to the Navy. The treatment methods are mainly presented from a waste management perspective and only minimal technical and operating details are presented. While the relative advantages and disadvantages of each method are presented, no conclusion can be made as to the best or preferred method that should be used by the Navy as this decision must be made on a site specific basis.

The treatment methods which are presented represent the technologies that are most widely accepted and used. However, as regulation of infectious waste continues to change, new technologies for treating the waste will continue to emerge and be evaluated. Also, Federal, State and local air pollution regulations are having a tremendous impact on methods used to treat infectious waste. Currently, this impact is mainly affecting the use of incineration, however, States are beginning to establish standards for the use of microwave sterilization, steam sterilization and chemical disinfection.

Table VII shows a comparison of the treatment technologies which are discussed in the following sections. These technologies include incineration, steam sterilization, chemical disinfection and microwave sterilization. Landfill disposal and contracted disposal are also addressed in this chapter. However, these disposal techniques are not included in Table VII as they are not treatment technologies in themselves. Landfill disposal typically relies on a treatment technology prior to disposal and contracted disposal uses one or more of the

technologies usually at an off-site location. Table VII was modified from Table 5.1 from Infectious Waste and Medical Waste Management by Gordon and Reinhardt (1991).

Table VII Comparison of Treatment Technologies

Factor	Type of Treatment Technology			
	Incineration	**Steam Sterilization**	**Chemical Disinfection/with shredding**	**Microwave Sterilization/with shredding**
Operations				
Applicability	Almost all infectious wastes	Most infectious wastes	Most infectious wastes	Most infectious wastes
Equipment operation	Complex	Simple	Moderately complex	Moderately Complex
Operator requirements	Highly skilled	Trained	Well trained	Well trained
Waste segregation	Very little	Must eliminate non-treatable waste	Must eliminate non-treatable waste	Must eliminate non treatable waste
Load standardization	Non-uniform loads will increase the complexity of operation	Needed	Needed	Needed
Effect of treatment	Waste completely destroyed	Appearance of waste unchanged	Waste is shredded to become unrecognizable	Waste is shredded to become unrecognizable
Volume reduction	85 - 95 %	< 30 %	Up to 85%	Up to 85%
Occupational hazards	Moderate	Low	Moderate	Low
Testing	Complex, expensive	Easy, inexpensive	Under development	Easy, inexpensive
Potential side benefits	Energy recovery	None	None	Use of residue as fuel
Onsite/offsite location	Both	Both	Both	Both

Table VII Continued

Factor	Type of Treatment Technology			
	Incineration	Steam Sterilization	Chemical Disinfection/with shredding	Microwave Sterilization/with shredding
Regulatory Requirements				
Medical waste tracking regulations	Apply in demonstration States	Apply in demonstration States	Apply in demonstration States	Apply in demonstration States
Federal Regulations apply to	Air emissions, ash disposal, wastewater from scrubber	Wastewater discharge	Wastewater discharge	Wastewater discharge
In addition, State may regulate	Air emissions	Air emissions	Air emissions	Air emissions
Disposal of Residue	Ash may be a hazardous waste subject to RCRA	Effluent to sanitary sewer/Residue to landfill-may require shredding dependent on State Reg.	Effluent to sanitary sewer/residue to landfill	Effluent to sanitary sewer/Residue to landfill
Permit requirements	Air Pollution Permit	Usually none	Usually none	Usually none
Costs				
Capital Costs	Extremely High	Low	Moderate	Moderate
Labor Costs	High	Low	Low	Low
Operating Costs	High	Low	Moderate	Low-Moderate
Maintenance Costs	High	Low	Moderate	Moderate
Downtime	High	Low	Moderate	Moderate

6.1 Incineration

In 1989, an American Hospital Association survey showed that sixty-seven percent of the nations nearly 6900 hospitals used on-site incineration (Shumaker, 1990). As stated by the EPA, "the primary objective of hospital waste incineration is the destruction of pathogens in infectious waste" (EPA, 1991). However, additional benefits of incineration include the

fact that the waste is rendered unrecognizable and that there is little or no residual or treated waste to subsequently dispose of. In fact, if air pollution requirements and costs associated with compliance could be overlooked, incineration would be the ideal method of treatment for infectious waste. Obviously, the air pollution and cost considerations can not be overlooked, thus incineration is becoming a thing of the past for infectious waste treatment at many facilities. While 384 medical waste incinerators were in operation in New York in 1990, only 50 to 75 of these were estimated to be able to comply with air pollution requirements in order to remain in operation by the end of 1991 (Modern Healthcare/December 9, 1991).

With existing incinerators, it is often not economically feasible for a hospital to upgrade the incinerator to meet air permit requirements. When considering a new incinerator, it is possible that by the time the incinerator is programmed, designed and constructed, the air pollution requirements will have changed so significantly that the operation will not be able to be permitted. During 1990, I observed several classified advertisements in trade magazines for incinerators which were constructed in California and could never be operated. These incinerators were for sale by the hospitals which owned them in attempt to sell them to a facility in a state with less stringent air pollution requirements.

Even regional incinerators, which attempt to take advantage of economy of scale, are finding it difficult to operate cost effectively. Browning Ferris Industries (BFI) recently closed its southern California infectious waste incineration facility when it could no longer comply with air pollution requirements. BFI now uses steam sterilization for its regional infectious waste operations in California. BFI is also constructing a regional steam sterilization facility in Texas because of the troubles associated with incineration permitting. Currently, infectious waste which is disposed of by contract in central Texas is shipped to Louisiana for its ultimate disposal.

Prior to any extensive regulation of infectious waste, hospitals often had incinerators that were designed mainly for the incineration of pathological wastes. These wastes include recognizable body parts or body tissues as described in Chapter 3. As regulation of infectious waste increased, so did the volume and number of different types of infectious

waste. This simply increased the quantity and types of wastes which were incinerated in the incinerators which were originally intended for pathological waste. Pathological waste has a much lower heating value than the current infectious waste stream which contains large quantities of paper and plastic. The addition of these materials with significantly higher burning temperatures caused operation and maintenance problems in the pathological incinerators.

This scenario is exactly what occurred over the 15 year operation period of the incinerator at Naval Hospital, Camp Pendleton. Additionally, the incinerator at Camp Pendleton became a convenient disposal point for non-medically related wastes which required special handling. These wastes included such items as confiscated marijuana, sensitive documents, reels of sensitive magnetic tapes and American flags that had accidentally touched the ground. While all of these items were legally disposed of from the standpoint of their particular handling requirements, (i.e. in accordance with security requirements or consistent with Navy/Marine Corps policy) the incinerator was explicitly permitted for pathological wastes only. Therefore, the disposal of items other than pathological wastes constituted operation of the incinerator outside the limits of its permit. Further, each day of operation outside the permit requirements was potentially subject to a $10,000 fine and six months imprisonment. This example is presented in order to indicate some of the risks or vulnerabilities associated with operation of an incinerator. Well intended practices and procedures can evolve to the point of being serious violations of law. Fortunately, in this case the practice was stopped prior to any violations being issued. Eventually the incinerator was shut down because it could no longer comply with air pollution standards even on the waste that it was designed to burn.

When properly designed and operated, incinerators can provide effective destruction of all classifications of infectious waste. As described in Chapter 3, hazardous wastes may be present in the medical waste stream. If the incinerator is not specifically permitted to burn hazardous wastes, these wastes must be dealt with through some other method of disposal in compliance with RCRA. An additional concern with incinerators is that the ash may exhibit characteristics of hazardous waste even though the materials which were incinerated were not hazardous wastes. This will result in the requirement that ash removed

from the incinerator be disposed of as a hazardous waste.

6.2 Steam Sterilization

Steam sterilization is rapidly gaining popularity as an effective method for treating infectious waste. The units are easy to install, operate and maintain and offer both individual hospitals and large regional facilities a cost effective alternative to incineration. Steam sterilization uses saturated steam under pressure for a predetermined exposure time in order to destroy pathogens. In reality, the waste is not completely sterilized, however, the term sterilization is commonly used to describe the process. The effectiveness of treatment is usually measured by placing cultures of indicator organisms in batches of the waste and then measuring the survival of these organisms. State regulation of the process is usually consists of specification of the minimum exposure time and temperature, and frequency of monitoring for effective pathogen destruction.

Steam for the process can either be generated by the sterilization unit or can be obtained from a steam source already available at the facility. Hospitals typically have abundant steam for such purposes as heating, cooling, cooking and other sterilization procedures within the hospital. When steam is already available at the facility it adds to the cost effectiveness of the process.

Upon completion of the sterilization process, the waste can usually be disposed of in the normal trash compactor followed by landfill disposal. However, some states require the sterilized waste to be rendered unrecognizable prior to landfill disposal. Sometimes this requirement only applies to certain classes of waste, such as anatomical body parts or sharps. The concerns with sharps relate to the occupational hazards to waste disposal workers and to the fact that syringes remain useable after sterilization and thus cause a risk of drug users obtaining the syringes from the disposed waste. When restrictions apply to certain classes of waste, hospitals can use contracted waste disposal services to dispose of items which can not be sterilized.

Steam sterilization is particularly attractive for military bases which operate their own

landfill. The residual waste from the sterilization process is inexpensive to dispose of in a government owned landfill. Also, because the waste never leaves the confines of the base, the risk of identifiable medical waste turning up in public places is greatly reduced.

Upon closure of the Camp Pendleton incinerator, the hospital immediately went to contracted disposal at a cost of $60,000 to $70,000 per year. Currently, the hospital is procuring a steam sterilization unit to replace the majority of the contracted services. One proposed steam process was estimated to save the hospital more than $478,000 in operating costs over a seven year period. Capital costs for the project are estimated to be approximately $70,000. However, this cost also included the scheduled replacement of the hospital's general waste compactor. The existing compactor was beyond its useful life and had become a maintenance problem. The proposed compactor included a automatic cart tipping system that simplified both infectious and non-infectious waste handling operations. In fact, once the waste was loaded into carts throughout the hospital, it would not require any additional direct handling prior to disposal in the compactor.

The major disadvantages of a steam sterilization system are that the waste volume is not reduced significantly and the wastes remain recognizable. Also, depending on State or local regulations, the process may not be suitable for treatment of chemotherapy or some pathological wastes.

6.3 Chemical Disinfection

Chemical disinfection can be used to treat solid and liquid infectious wastes. However, solid wastes must be shredded or granulated as part of the process. Solid wastes that are left intact would only become disinfected on the surface. A chemical disinfection system typically uses a shredder and auger to physically destroy the waste. During this process or immediately afterward, a chemical oxidant is mixed with the disintegrated waste in order to cause destruction of pathogens. The chemical oxidant most commonly used in the process is sodium hypochlorite. Following the chemical treatment, the waste is dewatered. Some processes recycle most of the disinfecting solution while others discharge all of the

liquid. Control features can include metal detection upon entry of the waste to the system. In most of these systems, metal must be removed in interest of protecting the shredding device.

Most states have not yet developed operating standards for chemical disinfection systems. It is difficult to determine effectiveness of treatment for waste that is shredded because cultures of indicator organisms that could be exposed to the process would also be shredded. Another disadvantage to the system is that wastewater discharged from the unit may not be suitable for discharge to the sanitary sewer. The combination of the shredding process with the washing process can lead to excessive organic and suspended solids loading. Before selecting this process, regulations for discharge to the sanitary system must be checked to ensure that the discharge will be allowed. Future regulation of these systems may include air emissions. It is possible that the shredding process can cause infectious agents to be emitted as aerosols. Some chemical disinfection units use High Energy Particulate Attenuating (HEPA) filtration to effectively control the emission of infectious agents in the exhaust (Winfield Industries, 1991).

6.4 Microwave Sterilization

Microwave treatment of infectious waste involves shredding the waste and then using microwaves to thermally destroy the pathogens. The system offers the advantages of chemical treatment, (i.e. the waste is rendered unrecognizable) without the requirement for chemical addition and possible wastewater discharge problems. While microwave sterilization has been in use in Europe since 1985, the first unit did not operate in the United States until March 1990 (ENR: January 7, 1991).

States have not yet developed standards for operation of a microwave system and no requirements for air or water pollution permits could be found. However, as the technology becomes more widely used and tested standards are sure to be developed. Future regulation of the systems may be in the area of air pollution control. The State of New York is reported to be the first state to be developing operating standards for microwave systems

(Modern Healthcare: December 9, 1991).

Capital costs for a microwave treatment system are in the range of $600,000. These costs are high when compared to a steam sterilization system. However, the microwave system is significantly less costly than an incinerator. One disadvantage of the process is that microwave systems are not suitable for treatment of pathological wastes, chemotherapy wastes or animal carcasses. Hospitals which select a microwave system will be required to have an alternate method, such as contract disposal, for wastes which are not suitable for microwave treatment.

6.5 Contracted Disposal

Contracted infectious waste disposal typically uses one of the treatment methods described above, however, the treatment occurs off-site and the treatment facilities are not owned by the hospital. While contracted disposal is often more expensive than on-site treatment, it reduces the hospitals risk of sinking a large capital expense into a technology that may become prohibited by rapidly developing regulations. Contracted disposal can also offer flexibility when waste quantities fluctuate greatly. That is, if a hospitals infectious waste generation exceeds the capacity of the on-site treatment system it takes a long time to develop greater on-site capacity. However, with contracted disposal, if the quantity of waste generated increases, the contract can rapidly be modified to adjust to the new quantity of waste.

Contracted disposal does place some increased risk on a facility in terms of accountability or responsibility for the waste. It is the responsibility of the generating facility to ensure that the infectious waste contractor is running a legitimate operation which is in compliance with all applicable laws. On January 13, 1991, the New York Times reported that 160,000 pounds of medical waste were found illegally stored in Port Jervis, New York. This waste had been collected by a firm that had a permit to collect and transport the waste, but did not have a permit to store or treat the waste. It was also reported that the waste had been accumulated over a period of several months. It was apparent that the contractor was charging hospitals for the proper disposal of the waste and then was simply storing the waste

in tractor trailers. While it is not known who eventually paid for the proper disposal of the waste, the point is made that potentially the hospital which generated the waste could be held liable for the cost of disposal. Legitimate infectious waste contractors often offer tours of their facilities and upon completion of these tours they issue certificates to their clients. Through this process, a hospital can document that a reasonable effort was made to check the legitimacy of the contractor. While this may not relieve the hospital of ultimate responsibility for the waste, it does show the intent of the hospital to comply with applicable regulations.

In order to prepare a specification for an infectious waste contract, close coordination is required between contract experts, the medical staff and the facilities management personnel. The contract must be flexible enough to handle the normal variations in waste quantity, yet a firm estimate of the quantity is required in order to create a fair and competitive bidding environment. The contract should also include provisions for handling special types of waste such as antineoplastic drugs. These substances are classified as hazardous wastes and are described in Chapter 3. Representatives from the medical staff will be better able to determine the frequency and quantity of these wastes than personnel not familiar with the medical procedures. It is also useful to consult the agencies which regulate medical waste as to some of the possible pitfalls of infectious waste contracting. The time spent in developing an adequate specification for infectious waste disposal will far outweigh the problems which can be encountered with a poor specification.

7.0 Improving the Navy's Management of Infectious Medical Waste

On a national level, the effective management of infectious waste has only been of concern since 1988. Since that time, infectious waste management techniques, policies and regulations have rapidly evolved. In the most extreme cases, this evolution of infectious waste management has resulted in the waste being managed to the same degree as hazardous wastes. As of July 1992, the Navy's infectious waste policy has been directed largely at the minimization of occupational hazards to healthcare professionals with less emphasis on controlling the costs of infectious waste disposal. This is due to the fact that the major policy document for infectious waste management (BUMEDINST 6280.1) is primarily authored and revised by the Navy Environmental Health Center (NEHC), with not much input from personnel skilled in the management of wastes beyond the point of generation. As a result, the document is fairly adequate in addressing occupational health and safety aspects, but is lacking in proper guidance for the engineering issues of infectious waste management. Throughout this report, weaknesses in the Navy's overall management of infectious waste have been identified. The intent of this chapter is to establish a framework by which these management weaknesses can be improved.

7.1 Organizational Structure of Infectious Waste Management Within the Navy

The organizational structure by which policy for infectious waste management in the Navy is developed is not well defined. As discussed in Chapter 4, the Chief of Naval Operations establishes the policy for environmental compliance through OPNAVINST 5090.1. In regard to infectious waste, the OPNAV policy then directs interaction between Naval Facilities Engineering Command (NAVFAC), Naval Sea Systems Command (NAVSEA), Bureau of Medicine and Surgery (BUMED) and all of the potential generators of

infectious waste. However, it does not appear that this interaction is well defined nor that one agency is ultimately in control of infectious waste policy. NAVFAC is directed by Section 10-6.1 to be the "technical focal point for solid waste management issues." NAVFAC's responsibilities to this regard are further described as:

- *Maintain appropriate technical directives, design manuals, and operational manuals concerning solid waste source reduction, collection, storage, disposal, and resource recovery.*
- *Develop and maintain solid waste reporting and information systems.*

Section 10-6.2 directs BUMED to ensure that the instruction on infectious waste management for Navy medical treatment facilities is current and to ensure that subordinate commands comply with all regulations regarding the identification, generation, handling, storage, transport, treatment and disposal of infectious waste. Several conflicts or discrepancies exist between these directives. First, infectious waste is a solid waste per the Resource Conservation and Recovery Act definition for solid waste. As such NAVFAC is tasked to manage infectious waste, including its source reduction, collection, storage, disposal and resource recovery. Second, if BUMED is to manage infectious waste, source reduction should be included as a part of its management requirements. Finally, if it was intended that the two agencies work together in developing an infectious waste management policy, it is not stated so.

The interaction of NAVSEA with BUMED and NAVFAC regarding infectious waste management is also not clear in the OPNAV policy. Section 17-5.8 requires that shipboard labeling, handling, and storage of potentially infectious medical waste shall be per Chapter 10. This statement neglects to mention source reduction, collection, identification, generation, treatment, and disposal. Since most of the shipboard infectious waste is stored and ultimately disposed of when the ship is in port, all of the guidance which applies to the shore based medical treatment facilities should also be appropriate for ships with the exception that some additional guidance is required for the special constraints that apply to ships. It is also noted that in dealing with infectious waste management in foreign countries, Section 10-5.7 requires that in the absence of other stationing agreements, infectious waste should be handled as specified in Chapter 17. However, as just described, Chapter 17 refers

back to Chapter 10. Furthermore, Chapter 17 is titled "Pollution Prevention Afloat" and its scope is stated to be that it is applicable to shipboard operations.

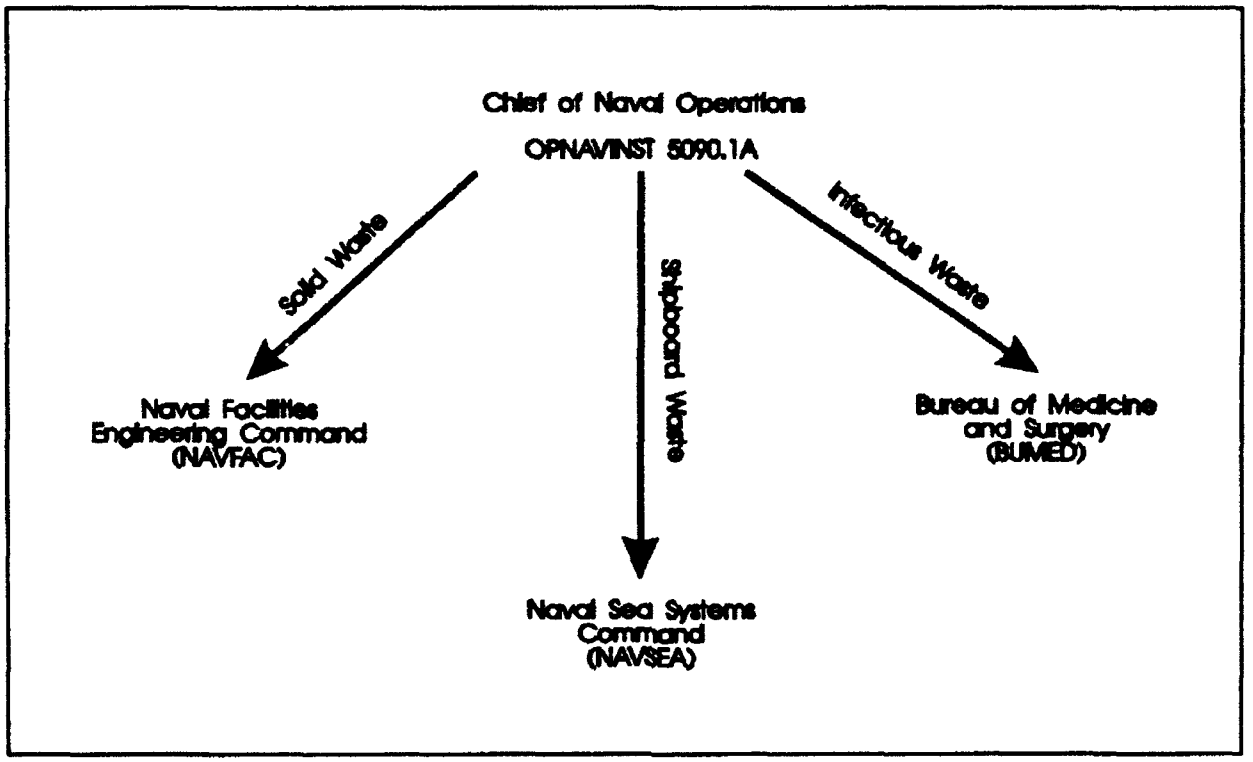

Figure 5 Current Infectious Waste Management Structure

The current structure of infectious waste management in the Navy is shown in Figure 5. In this scheme, there is little or no inter-dependency of the solid waste management, the infectious waste management and the shipboard waste management. However, these management issues should not be separated. Infectious waste is a subcategory of solid waste and shipboard infectious waste is a subcategory of infectious waste. The same management concepts that apply to general solid waste still have applicability to infectious waste and even to that particular infectious waste which is generated aboard ship. The only difference is that infectious waste has additional requirements above and beyond those for solid waste, and shipboard infectious waste has additional requirements above and beyond those for infectious waste generated ashore.

A more effective approach to the infectious waste management structure would be to make NAVFAC oversee the infectious waste management program. BUMED would be

responsible for the identification, categorization and infection control aspects of infectious waste. And NAVSEA would be responsible to specifically tailor the program to meet the requirements of shipboard infectious waste management. This management structure is proposed in Figure 6.

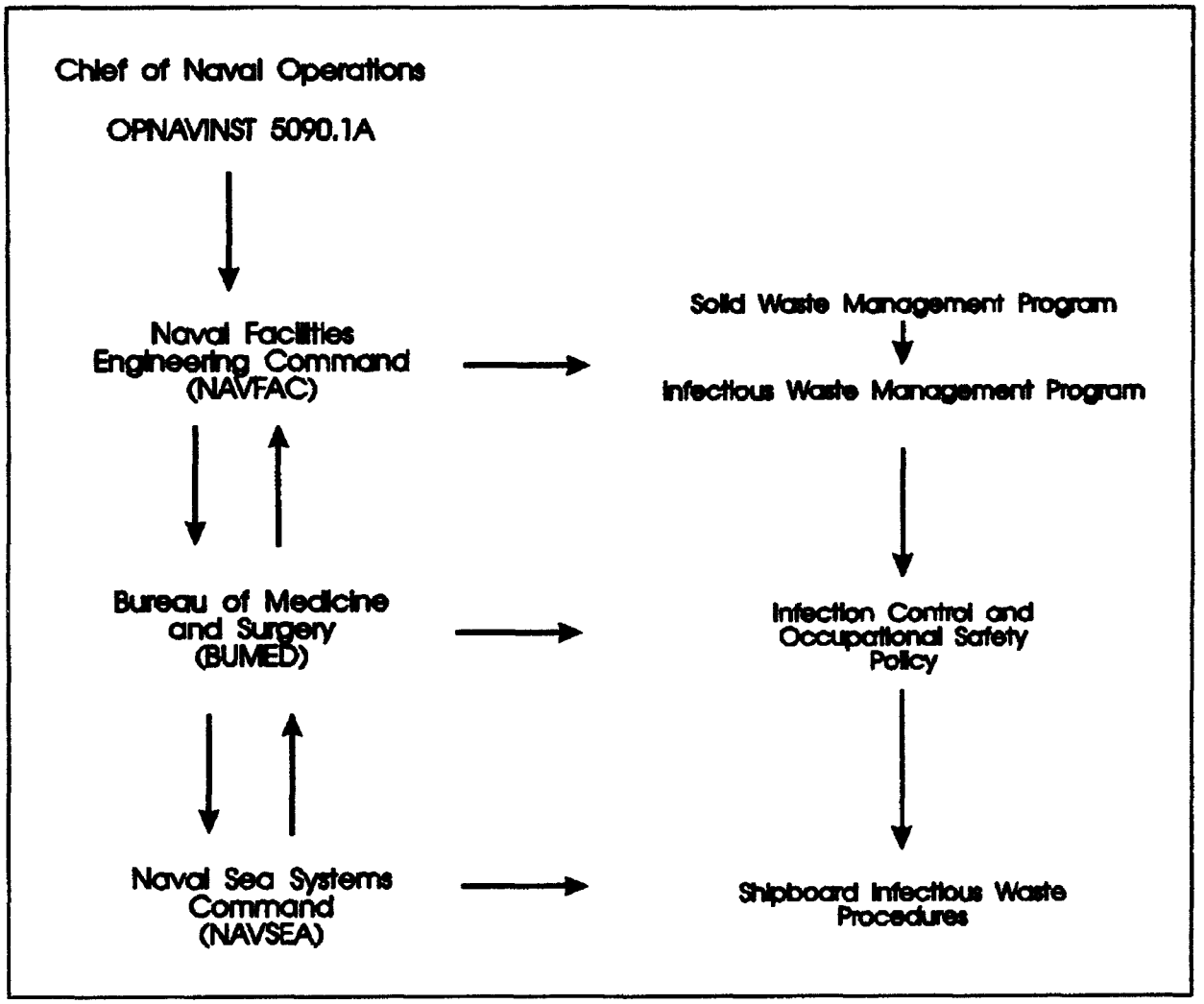

Figure 6 Proposed Infectious Waste Management Structure

With this proposed structure, the expertise of each agency is used appropriately to establish an effective infectious waste management program. NAVFAC has expertise with waste management and environmental compliance. BUMED has expertise with infection control and the occupational risks that infectious waste creates in the healthcare workplace.

NAVSEA has expertise in the logistical constraints of conducting business aboard ship.

7.2 Risk Assessment

The outcomes of the risks involved with infectious waste management can take the form of workers' compensation claims, fines, lawsuits, loss of accreditation, criminal penalties (Reinhardt and Gordon, 1991). Additional outcomes may include poor relations with the public and the payment of excessive costs for waste disposal. The risks that cause such outcomes can be categorized as occupational, environmental, legal, political, social, or economic (Reinhardt and Gordon, 1991). In evaluating each risk, assessment of the probability of a negative outcome must be done. The Navy conducts healthcare in countries throughout the world and on the open seas. Many of the Navy's locations are in coastal regions that are highly desirable places to live. Also, the Navy's presence in a particular location is not always completely welcome by the public in that location. Because of these factors, the risks associated with infectious waste management in the Navy are amplified in that the probability of a negative outcome due to mismanagement of infectious waste is increased.

Occupational risks from infectious waste are generally in the form of the exposure of an employee to pathogens. When conducting healthcare on a ship or in the field as opposed to in a hospital, occupational risks are increased by cramped working conditions, the presence of many other activities going on in the immediate area, and by the necessity to carry or store infectious waste instead of being able to directly dispose of it. Occupational risks are also increased by the high rate of turnover of personnel in the military. This causes a continual flow of new personnel who must be trained to avoid the risks associated with infectious waste.

The social risks that are associated with infectious waste are mainly the poor public relations that are caused when mismanagement of infectious waste occurs or even when there is a perception that there is mismanagement of infectious waste. Out of necessity, some treated infectious waste must be discharged from a ship. If a piece of this waste is found on

a beach or in the ocean and can be traced to the Navy, there is a tremendous public perception that the Navy is mismanaging medical waste. In locations where the Navy is not completely welcome, this perception can be used to fuel negative feelings toward the Navy in that location. This social risk then becomes a political risk for the Navy.

Legal risks include the violation of Federal, State, or local environmental regulations, occupational health and safety regulations, and legal disputes associated with waste disposal contracts. Environmental regulations not only include those regulations particular to medical waste disposal, but also include regulations for incinerator operations. Again, the wide range of locations and platforms from which the Navy conducts healthcare increases the legal risks associated with infectious waste management.

Because the risks associated with infectious waste management are increased for the Navy, the degree to which the waste is managed must also be increased. The changes to the management structure mentioned in the previous section become even more crucial upon assessment of the risks. The agencies which each have expertise in minimizing the various risks must work together to establish an effective management framework. Also, upon evaluation of the risks, it becomes apparent that as the volume of infectious waste that is generated is reduced, so will the risks that are associated with the management of that waste.

7.3 Waste Minimization

Waste minimization includes source reduction, recycling or reuse, waste segregation and waste volume reduction. The benefits of waste minimization are obvious, reduced costs and reduced risks of managing the waste. In a meeting on infectious waste at Camp Pendleton it was pointed out that it did not help the environment to separate infectious waste from non-infectious waste because in the long run it all is disposed of as trash in a landfill. That may be true, however the cost of infectious waste disposal far exceeds the cost of non-infectious waste. One researcher reported that "in some communities on the east coast, disposal costs for municipal solid waste run $100 dollars per ton, compared with $1,000 per ton for infectious waste (Reinhardt and Gordon, 1991).

In order to attempt to reduce the quantity of infectious waste generated, one must have first an adequate definition of infectious waste. The definition of infectious waste was discussed in Chapter 3. It was stressed that a precise definition for each type of infectious waste must be developed and used throughout the Navy. Even though each type of waste may have different handling requirements in different states, the uniformity in the definition is essential to effective waste management. It was suggested that the definition to be used should follow the current EPA definition as provided by the Medical Waste Tracking Act.

Infectious waste reduction also requires a knowledge of the composition of the current wastestream. Throughout this report, examples were presented regarding the occurrence of non-infectious waste in the infectious waste bags. Once an infectious waste reduction program is started, continuous monitoring of the infectious wastestream is required to identify the source of red bag misuse. In the early stages of a waste reduction program, monitoring must be more frequent and must include a high percentage of the facility. However, monitoring is easy to do and need not take an inordinate amount of valuable staff time. At Camp Pendleton, a monitoring program was established in which an approximately thirty minute period was spent two times per day. During this time, a tour of different parts of the hospital was conducted with a polaroid camera. Photographs were taken of red bags that contained excessive amounts of non-infectious waste. The photographs were than immediately labeled with the location of the infectious waste receptacle. An example of a monitoring photograph is presented in Appendix B. In the early stages of the process, the photographs were used to show the department heads the misuse of red bags that was occurring in their department. The photographs also were used to identify the departments that were the greatest source of red bag misuse so that repeated monitoring efforts could be focussed at the greatest problem areas. A benefit of using photographs is that the contents of the bag do not need to be touched in order to document the contents and where it originated. This consideration is important in deciding on a monitoring program. Once the bags are removed from the generation point they must be opened to reveal the contents and it becomes hard to identify where the bag was generated. Opening the bag may lead to unnecessary occupational exposure to the person that is doing the monitoring. No matter what type of monitoring is decided upon, the infection control staff should be consulted to ensure

occupational safety.

Another key factor in the success of a waste reduction problem is to gain the support of the highest level of the organization. This is often easily accomplished by showing upper management a copy of a contractors monthly invoice for infectious waste disposal. At the Camp Pendleton hospital, the Executive Officer (XO) and the Commanding Officer (CO) became very interested in and were very supportive of the infectious waste disposal program. As the program progressed, the monitoring photographs for repeated problem areas were submitted to either the XO or the CO. The XO or CO would than attach a note to the photograph and send it back to the department where it was taken. In extreme cases, instead of taking a photograph, the entire red bag was confiscated and brought to the CO or XO's office. The XO was than known to personally return the bag to the department from which it came. This process was very effective for rapidly stressing the importance of infectious waste reduction. It is noted that departments which were particularly successful in waste reduction were also reported to the upper management of the hospital. Within 2-3 weeks of this programs initiation, infectious waste reductions fluctuated between 25 and 50 percent. This reduction was purely a result of removing things from red bags that clearly did not belong there (i.e newspapers, packaging etc.). It did not attempt to reduce items that were in a grey area, such as gauze with a few drops of blood on it.

Education and training programs within the healthcare facility must address the proper waste disposal procedures and must stress the excessive cost that results from improper disposal. Without training, all other attempts to reduce infectious waste will be futile. An example of this was evidenced at the Bergstrom Air Force Base Hospital in Austin Texas. A common technique to minimize infectious waste is to provide both an infectious waste and a non-infectious waste container in each treatment room. Although this was done at the Bergstrom hospital, the medical staff made no distinction between the two receptacles. One dermatologist performing a minor surgical procedure was observed at two different times during the procedure to remove a pair of surgical gloves. The first pair was removed after examination of the patient's thumb but prior to any actual treatment. This pair of gloves was disposed of in the infectious waste container. The doctor than washed his hands, took several paper towels to dry his hands, and disposed of the paper towels in the infectious

waste container. The second pair of gloves, which was removed after the actual surgical procedure were disposed of in the normal trash receptacle. Also disposed of in the red bag was all of the packaging from the sterilized instruments used in the procedure. Photographs of these waste receptacles are shown in Appendix B. During the same visit to the Bergstrom hospital, a red bag was observed to be used as a liner for a normal trash receptacle in a patient waiting area. The red bag was probably more convenient to the person who emptied the trash that day. Both of these examples stress the importance of waste disposal training in a healthcare facility. At Camp Pendleton, this training was included in the indoctrination training that all new staff attend upon arrival to the facility.

With infectious waste, recycling or reuse is generally limited to the replacement of disposable items with reusable items. It is not really feasible to consider removing paper or plastic items from the infectious waste stream for the purpose of recycling. However, the use of reusable cloth sheets or hospital gowns instead of disposable products is very feasible. Over recent years, the trend has been for hospitals to use more and more one use, or disposable items. Rising costs of infectious waste disposal has renewed interest in going back to launderable or reusable products. Researchers reported that technological advances have resulted in reusable fabrics have resulted in items that are "equal to their disposable counterparts in comfort, liquid repellence, and infection rate and analysis by hospitals converting to reusable products has reported cost savings and no performance problems" (Tieszen and Gruenberg, 1992). The same study showed that volume reductions of 93% percent could be achieved in surgical waste. In evaluating the cost of reusable products versus disposable products, it has become necessary to include the cost of infectious waste disposal.

7.4 Waste Management Plans

An infectious waste management plan establishes and documents an organization's policies and procedures for the effective management of infectious wastes. The strategic objectives of the infectious waste management plan, as described in Infectious and Medical

Waste Management (Reinhardt and Gordon, 1991), should be to:

- Reduce risks and liabilities
- Control costs
- Plan for future changes in operations and regulations
- Document the organizations commitment to human health and the environment

Table IX Outline of BUMEDINST 6280.1

BUMEDINST 6280.1
GUIDELINES FOR MANAGEMENT OF MEDICAL WASTE

1. Introduction

2. Infectious Waste
   a. Definition
   b. Segregation
   c. Packaging and Handling
   d. Storage
   e. Transportation
   f. Treatment and Disposal
   g. Manifesting and Recordkeeping
   h. Training

3. Noninfectious Waste
   a. Example (of noninfectious waste)
   b. Example (of noninfectious waste)

4. Cleanup of Medical Waste Spills

5. References

The Navy's current infectious waste management plan is BUMEDINST 6280.1. This plan serves as the guidance for each medical treatment facility to develop their site specific infectious waste management plan. A review of the outline of BUMEDINST 6280.1 shows that the document contains several essential items of an effective waste management plan. This outline is presented in Table IX. When the instruction is reviewed for compliance with

the four previously stated strategic objectives the following observations can be made:

- The instruction is fairly effective in reduction of the occupational risks, and somewhat less effective in reduction of the legal, environmental and financial risks associated with infectious waste management.
- The instruction does not adequately meet the objective of cost control.
- The instruction does not address the objective of long range planning.
- The instruction does not adequately communicate the Navy's commitment to protecting human health and the environment.

In comparison to BUMEDINST 6280.1, an outline presented in Infectious and Medical Waste Management (Reinhardt and Gordon, 1991) is presented as Table X. Some modifications have been made to the outline which has been referenced. Once the management plan is developed into a framework such as the one presented in Table X, each of the strategic objectives can be addressed. Meeting the objectives will also require a tightening of the language used in the document. This will include the use of:

- Precise and uniform definitions for the various classifications of waste as described in Chapter 3.
- Definitive specifications (such as ANSI or ASTM) on materials that are to be used in infectious waste management. These concepts were addressed in Chapter 5.
- Specific numerical goals to be achieved in waste minimization efforts. Waste minimization was addressed earlier in this chapter.

The reporting requirements shown in the outline are needed to evaluate whether the objectives of the plan are being met and to identify areas in which management can be improved. Some of this reported information can remain internal to the facility which generates the waste. However, a better accounting and monitoring of all infectious waste costs and volumes throughout the Navy is needed. The infectious waste data which is currently tracked by the Navy is discussed in Chapter 2. Long range planning for infectious waste management must also be tracked at Navy wide level. As regulations change and treatment equipment becomes outdated, new methods of treatment or disposal will be required to fill the gap. Obtaining capital improvements, large equipment or even contracted

Table X Suggested Outline for an Effective Infectious Waste Management Plan

I. Policy and Purpose of the Waste Management Program

II. Scope of the Management Plan
- A. Waste types
- B. Activities that generate infectious and medical wastes

III. Current Management Methods
- A. Identification
- B. Collection
- C. Storage
- D. Treatment
- E. Transportation
- F. Disposal

IV. Responsibilities and Employee Training

V. Waste Minimization Efforts and Goals

VI. Occupational Safety

VII. Emergency and Spill Response

VIII. Quality Assurance

IX. Report Requirements
- A. Assessment of current management methods and attainment of minimization goals
- B. Assessment of regulatory compliance
- C. Waste management costs and quantity of waste generated
- D. Needs for meeting long range waste management planning
- E. Operational needs

waste disposal services in the Navy is an extremely long process. The generation of infectious waste will not cease in order to accommodate the lack of long range plans.

8.0 Conclusions and Recommendations

From this study of the Navy's management of infectious medical waste, the following conclusions can be made:

(1) Due to the Navy's presence throughout the world and the variety of platforms from which the Navy provides healthcare, the risks that are normally associated with infectious waste management are increased. This increase in risk requires the Navy to exercise increased management of infectious waste.

(2) The current structure of infectious waste management in the Navy is not conducive to providing effective management of infectious waste. An improved management structure is presented in this report (Chapter 7).

(3) Current Navy policy for infectious waste management is lacking in the areas of cost containment, long range planning, and communication of a commitment to protection of human health and the environment.

(4) The quantity of infectious waste generated by the Navy can be significantly reduced, thereby reducing the costs and risks associated with infectious waste management. Education of hospital staff and an effective waste monitoring program are essential to effective minimization of infectious wastes.

(5) A uniform definition and classification system for infectious waste is needed in

the Navy. This system should be based upon the most stringent of the widely varied definitions and classifications of infectious waste that exist throughout the Nation.

(6) Provisions are needed, in the applicable Navy regulations, to identify and segregate medical wastes which are classified as hazardous wastes by the Resource Conservation and Recovery Act (RCRA). These wastes are discussed in Chapter 3.

References

EPA 1991; Medical Waste Management and Disposal U.S. Environmental Protection Agency et al; 1991, Noyes Data Corporation, Park Ridge, New Jersey.

Murphy, LCDR, B. P. Personal Contact, Naval Hospital, Camp Pendleton, June, 1992.

Sorgen, LCDR, S. Personal Contact, Navy Environmental Health Center, June, 1992.

Cockram, J. Personal Contact, Navy Environmental Health Center, June, 1992.

Reinhardt, P. A., Gordon, J. G.; 1991 Infectious and Medical Waste Management; Lewis Publishers, Inc., Chelsea, Michigan.

Burkett, P. L., 1991; "The Infectious Waste Disposal Dilemma"; Environmental Protection, October, 1991.

Naval Sea Systems Command, 1991; "Shipboard Medical Waste Management Guidance" Draft, April 1991.

Bureau of Medicine and Surgery, 1991; "BUMEDINST 6280.1, Management of Medical Waste"; 25 March, 1991.

Tiezen, M. E., Gruenberg, J. C., 1992; "A Quantitative, Qualitative, and Critical Assessment of Surgical Waste - Surgeons Venture Through the Trash Can"; JAMA, May 27, 1992; Vol 267, No.20.

Lee, L. D., 1990; "Waste Management Policy For Healthcare Facilities", American Hospital Association, Technical Document Series, November, 1990.

Payton, J., 1990; "OSHA Update For Hospitals", American Hospital Association, Technical Document Series, May 1990.

Gold, A. R., 1991; "Garbage Company Faces Charges of Illegal Medical waste Storage", New York Times, January 13, 1991.

Associated Press, 1991; "Congressional Report Urges U.S. To Set a Policy on Medical Waste", New York Times, February 24, 1991.

Emmerman, J., 1991; "A Prescription for Cleaning Up Medical Waste", USA Today, May 1991.

Yarrow, A. L., 1991; "Company Drops A Plan to Build Brooklyn Plant - Navy Site Is Rejected for Medical Waste Center", New York Times, October 5, 1991.

Washington Post, 1991; "Va. Firm Drops Plan to Operate Medical Waste Facility", Washington Business, October 21, 1991.

Associated Press, 1991; "Beach Is Open at Riis Park", New York Times, September 2, 1991.

Lyall, S., 1991; "Beach Medical Waste: Debris but No Panic", New York Times, September 11, 1991.

Shumaker, M. R., 1990; "Infectious Waste: A Guide to State Regulation and a Cry for Federal Intervention", Notre Dame Law Review, Vol. 66:555, 1990.

Sugrue, D. E., 1991; "Protecting Our Surf From Syringes: The Comprehensive Regulated Medical Waste Management Act", Seton Hall Legislative Journal, Vol. 15:568, 1991.

Winfield Industries, 1991; "Condor Medical Waste Treatment System - Equipment Description", Winfield Industries, July, 1991.

R. E. Baker Company, Inc., 1991; Personal Letter to Lieutenant Patrick Hamilton, dated March 19, 1991.

ENR, 1991; "Medical market gets infectious - Regulation and liability prompt new medical waste disposal options", Engineering News Record, January 7, 1991.

Modern Healthcare, 1991; "N.Y. Agency to Issue Stringent Regulations for Treatment Facilities", Modern Healthcare, December 9, 1991.

Jones, L., 1992; "Stricter Medical Waste Rules Considered", American Medical News, May 18, 1992.

Loehr, R. C., 1991; Course Notes, CE 385J Hazardous Waste Management, Fall Semester 1991, University of Texas at Austin.

Appendix A

Bureau of Medicine and Surgery Instruction 6280.1

BUMED INSTRUCTION 6280.1

From: Chief, Bureau of Medicine and Surgery
To: Ships and Stations Having Medical Department Personnel

Subj: MANAGEMENT OF MEDICAL WASTE

Ref: (a) 29 CFR 1910.132(a) and (c)

Encl: (1) Guidelines for Management of Medical Waste

1. Purpose. To provide guidelines for the management of medical waste at medical and dental treatment facilities (MTFs and DTFs).

2. Cancellation. NAVMEDCOMINST 6280.1.

3. Background

a. Concern exists regarding the public's perception of potential adverse environmental or human health effects resulting from the disposal of medical waste. Medical waste is composed of solid and liquid waste resulting directly from patient diagnosis and treatment procedures. There is currently great concern about the public image of hospitals and clinics as sources of environmental pollution resulting from disposal of medical wastes. This concern exists even though there is no evidence to suggest that hospital waste is more infective than residential waste or that hospital disposal practices have caused disease in the community.

b. Medical waste may be divided into two categories: infectious and noninfectious waste. The definition, segregation, packaging and handling, storage, transport, treatment, disposal, monitoring, and training are essential elements for an effective medical waste management plan. Enclosure (1) provides current scientifically acceptable standards for Navy MTFs and DTFs, and is consistent with current Federal, State, or local guidelines and regulations, or all. Reference (a) provides guidance for personal protective equipment.

4. Action. Commanders, commanding officers, and officers in charge must:

a. Comply with existing State or local regulations or both, or status of forces agreements.

b. In locations which do not require the minimal standards described in this document, adopt these guidelines.

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GUIDELINES FOR MANAGEMENT OF MEDICAL WASTE

1. Introduction

a. Limited data suggests that treatment and disposal of medical waste may be a significant occupational health hazard to health care workers, but does not appear to adversely effect the environment. Recent public awareness and concern, however, has resulted in increased Federal, State, and local regulatory agency interest and response.

b. The absence of Federal regulations and conflicting guidance from the Environmental Protection Agency (EPA), Centers for Disease Control (CDC), and Joint Commission on Accreditation of Health Care Organizations (JCAHO) has stimulated creation of a variety of State and local regulations regarding medical waste. The purpose of these guidelines is to provide current, scientifically acceptable standards for Navy MTFs and DTFs which are consistent with current Federal, State, or local regulations or status of forces agreements. Chief, Bureau of Medicine and Surgery (BUMED) policy is to comply with existing State or local regulations, or both.

2. Infectious Waste

a. Definition. Infectious waste is liquid or solid waste that contains pathogens in sufficient numbers and with sufficient virulence to cause infectious disease in susceptible hosts exposed to the waste. Examples:

(1) Microbiology wastes including cultures and stocks of etiologic agents containing microbes that, due to their species, type, virulence, or concentration are known to cause disease in humans. Examples include specimens from medical and pathology laboratories, discarded live vaccines, wastes from production of biologicals, cultures and stocks of infectious agents from clinical research and industrial laboratories, and disposable culture dishes and devices used to transfer, inoculate, and mix cultures.

(2) Pathological wastes include human tissues and organs, amputated limbs or other body parts, fetuses, placentas, and similar tissue from surgery, delivery, or autopsy procedures. Animal carcasses, body parts, and bedding exposed to pathogens are also included in this category.

(3) Liquid waste human blood, products of blood, items saturated or dripping with human blood, or items that were saturated or dripping with human blood that are now caked with

dried human blood, pleurevacs, and hemovacs. (Absorbent materials, containing small amounts of blood or body fluids and discarded products for personal hygiene such as diapers, facial tissues, and sanitary napkins are not considered infectious.)

(4) Sharps, including hypodermic needles, syringes, scalpel blades, Pasteur pipettes, specimen slides, cover slips, glass petri plates, and broken glass potentially contaminated with infectious material.

(5) Medical wastes from isolation rooms are often defined as infectious waste. However, only those items which were contaminated or likely to be contaminated with infective material are infectious waste. Refer to CDC's, "Guideline for Isolation Precautions in Hospitals" for identification of material likely to be infective.

b. Segregation

(1) Separate infectious waste from noninfectious waste at its point of origin. Place the waste into receptacles lined with plastic bags of sufficient thickness, durability, puncture resistance, and burst strength to prevent rupture or leaks.

(2) Plastic bags should be of sufficient quality so that only one bag is needed for most situations. Secure the bags and mark them clearly with the universal biohazard symbol or the word "BIOHAZARD." Do not overload the bags.

c. Packaging and Handling

(1) Discard sharps, as defined in paragraph 2a(4), into rigid, puncture resistant sharps containers which have the universal biohazard symbol or the word "BIOHAZARD" shown clearly. Never clip, cut, bend, or recap needles. Close the containers securely when they are 3/4 full. Do not overfill! Collect the closed sharps containers and transport them carefully to the treatment or storage site. Discard sterilized sharps, contained in sharps containers, as infectious waste.

(2) Minimize human exposure to infectious waste during transport to treatment or storage areas. Do not transport infectious waste in chutes or dumbwaiters. Infectious waste must be sterilized and rendered noninfectious before compacting or grinding.

(3) Place all anatomical pathology waste in containers lined with leak-proof plastic bags for transportation and incineration in a biological incinerator. Logistical and ethical

constraints may require freezing this waste until biologic incineration, cremation, or burial by a licensed mortician is feasible.

(4) Blood, blood products, and other liquid infectious wastes.

(a) Decant bulk blood or blood products into clinical sinks (not hand-washing sinks), unless this practice is prohibited by State or local regulations. The emptied containers should be considered medical infectious waste. Place bulk blood which cannot be emptied safely (e.g., pleurevacs and hemovacs) into leak-proof containers for incineration.

(b) Decant suction canister waste from operating rooms into a clinical sink, if feasible, or close all ports securely and place the inner liner into sturdy, leak-proof containers for incineration.

(5) Wear protective apparel or equipment such as gloves, coveralls, mask, and goggles appropriate for the level of risk associated with the particular task. Refer to reference (a) for further guidance.

d. Storage. If infectious waste cannot be treated on site, the following storage requirements apply:

(1) Limit storage without refrigeration to 4-7 days, except in States with stricter requirements. Some State and local regulations allow longer storage time with refrigeration. Contact the local health department for specific information. Keep storage time to a minimum. Consider storage times when contracting for disposal.

(2) Store infectious waste in a designated storage area located at or near the treatment or transport site.

(a) Storage areas must be constructed to prevent entry of rodents and other pests and kept clean.

(b) The universal biohazard symbol or the word "BIOHAZARD" must be clearly visible on the outside of the storage area.

(c) Limit access to authorized personnel only.

e. Transportation

(1) Place infectious waste into rigid or semirigid, leak-proof containers before transporting off site.

(2) Refer to Federal, State, and local laws or regulations or status of forces agreements for other transportation requirements such as licensing and vehicle labeling.

f. Treatment and Disposal. Disposal of medical infectious waste must follow State and local requirements.

(1) Treat all infectious wastes before disposal.

(2) Treatment must follow recommended guidelines in table 1.

g. Manifesting and Recordkeeping

(1) Develop a practical system to monitor the disposal of medical waste.

(2) Basic elements of this system should include the date, type of waste, amount (volume or weight), and disposition.

h. Training

(1) Include a briefing on infectious medical waste and occupational disease hazards in the command orientation for all new employees and staff.

(2) Ensure continued staff training and active participation in the implementation of appropriate medical waste practices.

3. Noninfectious Waste. Medical waste determined to be noninfectious will be treated as general waste, using currently accepted methods of collection, storage, transport, and disposal.

a. Example: Absorbent materials containing small amounts of blood or body fluids (e.g., dressings, chucks, diapers, facial tissues, and sanitary napkins with blood or body fluids which are not unabsorbed or free-flowing) may be placed into trash receptacles lined with durable plastic bags and discarded with other ordinary waste.

b. Example: Nonsterilizable disposable products used during routine dental procedures, i.e., rubber gloves, rubber dams, cotton, and paper products.

4. Cleanup of Medical Waste Spills

a. Promptly clean up all leaks and spills of medical waste within hospitals or clinics.

b. Personnel must wear appropriate protective apparel or equipment, such as gloves, coveralls, mask, and goggles, to prevent exposure to infectious waste when cleaning up spills.

c. Remove blood and body fluid spills with an absorbent material and disinfect the area with an EPA approved disinfectant detergent or a solution of sodium hypochlorite (household bleach) diluted 1:10 with clear water.

5. References

a. CDC. Guidelines for Handwashing and Hospital Environmental Control. 1985.

b. CDC. Recommendations for Prevention of HIV Transmission in Health-Care Settings. MMWR Sup 2S. August 1987; Vol. 36.

c. CDC. Update: Universal Precautions for Prevention of Transmission of Human Immunodeficiency Virus, Hepatitis B Virus, and other Bloodborne Pathogens in Health-Care Settings. MMWR. June 24, 1988; Vol. 37, No. 24.

d. EPA. Guide for Infectious Waste Management. PB86-199130. May 1986.

e. Garner JS, Simmons BP. CDC. Guidelines for Isolation Precautions in Hospitals. Infection Control, July 1983; Vol. 4 (Suppl). pp 245-325.

f. Slavik NS. Report on the Proceedings of the EPA Infectious Waste Management Meeting, November 12, 1987. 1988. EPA Headquarters, Washington, D. C.

g. Wenzel RP, Ed. Prevention and Control of Nosocomial Infections. 1987. pp 257-282. Williams and Wilkins, Baltimore, MD.

Table 1

TREATMENT AND DISPOSAL METHODS FOR INFECTIOUS MEDICAL WASTE [1]

Type of Medical Waste	Methods of Treatment	Methods of Disposal
Microbiological	Steam Sterilization [2] Chemical Disinfection [3] Incineration [4]	Sanitary Landfill
Pathological [5]	Incineration Cremation [3]	Sanitary Landfill Burial [6]
Bulk Blood		Sanitary Sewer [7] Incineration
Suction Canister Waste from Surgery		Sanitary Sewer Incineration
Sharps in Sharps Containers	Steam Sterilization Incineration	Sanitary Landfill Sanitary Landfill

Notes:

1. These procedures for managing medical waste are considered the most appropriate. However, alternative treatment and disposal methods may be used if effective and environmentally sound.

2. For effective sterilization, the temperature must be maintained at 121° C (250° F) for at least 90 minutes, depending on the size of the load and the type of container. Bacillus stearo-thermophilus spore strips must be used weekly to test the sterilization process.

3. Chemical disinfection is most appropriate for liquids.

4. Any ash remaining after incineration must go to the municipal landfill or incinerator with noninfectious waste for disposal.

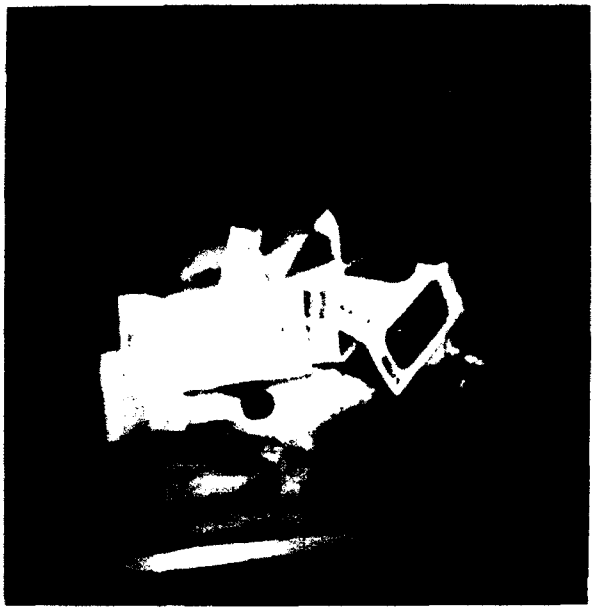
5. Disposal of placentas by grinding with subsequent discharge to a sanitary sewer is acceptable, if approved by State or local laws or regulations.

6. Burial or cremation by a mortician is acceptable.

7. Discharge to a sanitary sewer is acceptable only if approved by State or local laws or regulations.

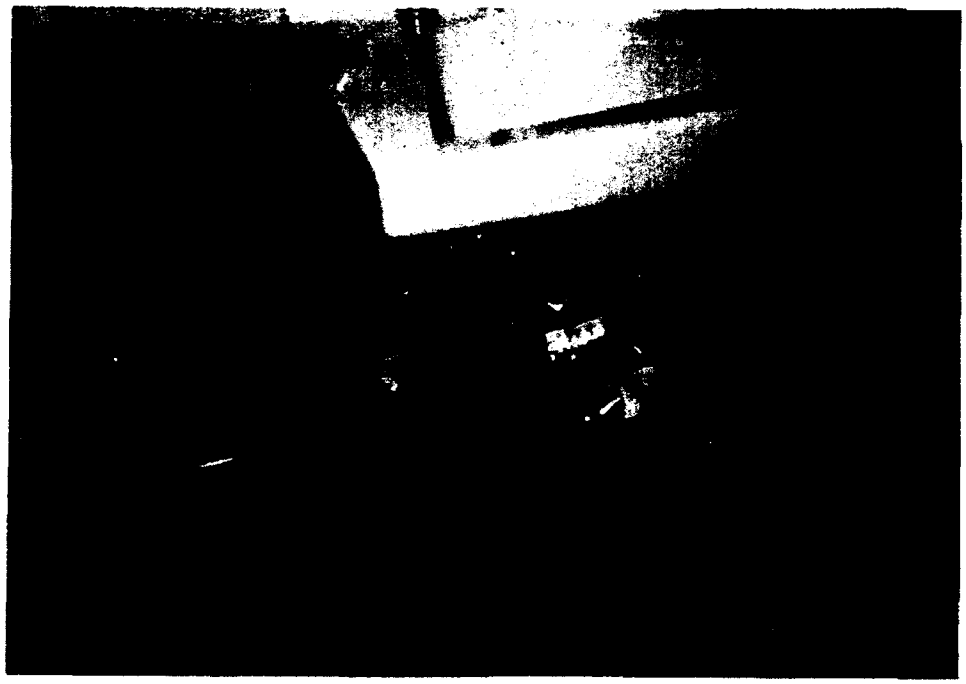
Appendix B

Photographs



5JUN91
LAB

Monitoring photograph used at Naval Hospital Camp Pendleton to track waste minimization efforts. Non-infectious packaging can be seen improperly disposed of in the red bag. The photo also identifies the date and location of the red bag.



Photographs of infectious and non-infectious waste receptacles at a military medical clinic. Although both types of receptacles are provided, segregation of the wastes has still not occurred. Non-infectious waste is readily apparent in the red bag.